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Engineering News-Record

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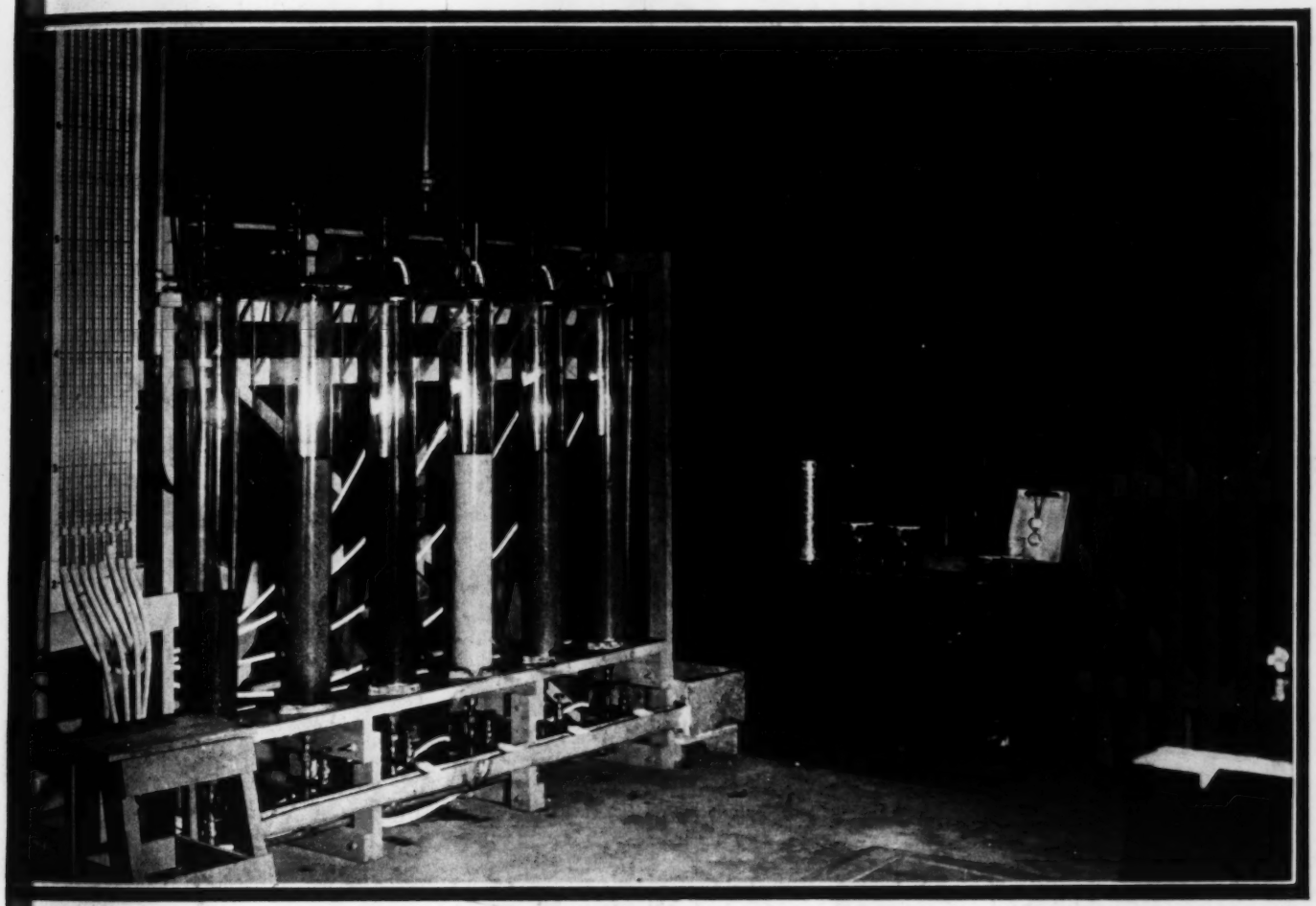

BETTER WATER, LIKE IMPROVED STEEL AND CEMENT, HAS ITS ANTECEDENTS IN THE RESEARCH LABORATORY
HERE FILTER SANDS ARE BEING STUDIED AT IOWA UNIVERSITY

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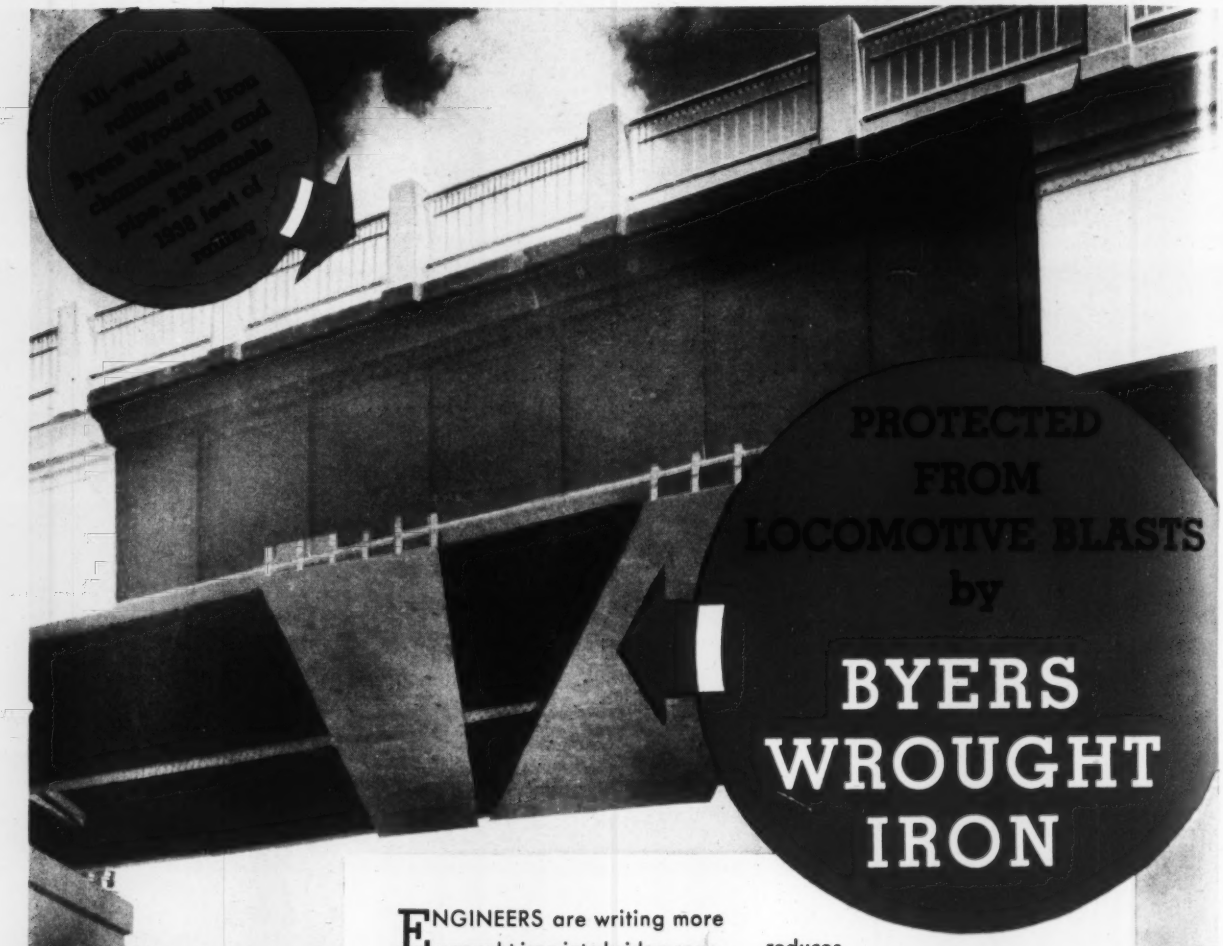
Kansas City's Municipal Auditorium
Rolled Concrete Pavement in Australia
Rigid Frames for Building Foundations
Lessons from the Construction Code—II

Report of New England Water Works Association Meeting



ENGINEERS are writing more wrought iron into bridge specifications today than at any time since the days of all-wrought iron bridges.

Illustrated is a typical example —the new Fort Worth Stock Yards Viaduct, extending over ten railroad tracks. The all-welded railing is made of Byers Wrought Iron channels, bars and pipe, while the blast plates are also of Byers Wrought Iron.

Hot sulphur-laden smoke blasts shorten the life of unprotected bridge structures. Blast plates of Byers Wrought Iron can withstand this corrosion as is proved by records of old wrought iron bridges still in service. A specification of wrought iron for blast plates reduces dead weight, facilitates fastening design, protects against corrosion and eliminates danger of cracking due to sudden temperature changes.

Other uses of Byers Wrought Iron in protecting bridges—such as track troughs, deck and protection plates, conduits and drains —are illustrated and described in the Special Report on "The Use of Wrought Iron in Bridge Construction." A copy may be secured through any Byers Engineer or our Engineering Service Department. A. M. Byers Company, Established 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston.

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Hazard as Well as Waste

"Here lies our Sovereign Lord the King
Whose word no man relies on,
Who never said a foolish thing
Nor ever did a wise one."

THESE LINES, said to have been written on the door of the second Charles' bedchamber, come vividly to mind as we contemplate the present situation of the work-relief project. No one ever has spoken more wisely than has the reigning Lord of the White House concerning the principles that should govern that effort; no one, by the acts of his subordinates, ever has violated more flagrantly his own wise precepts.

Of course, Charles had a ready retort for his critic: "Very true," he said, "for my words are my own, my actions are my ministers'." And until last week, the President also might have answered critics of the work-relief mess by citing his ministers' perversion of his original intent.

BUT NOW he appears to be taking on himself the burden of repudiating the specifications on which, less than a year ago, he got from Congress some $4,000,000,000 with which to carry out a carefully defined program. No longer is it a matter of Mr. Hopkins or Mr. Ickes; if the ideas of Mr. Hopkins prevail it will be because the President has substituted them for those on which he sold his program to the country.

Last week this page pointed out certain wastes and inequities that must result from the present tendency to sacrifice sound, normal practice in public construction on the altar of a rather dubious relief program.

But there is yet another aspect of the situation that lays a still heavier burden of responsibility on the administration's doorstep. Certain types of public works, notably those of water-supply and sanitation, touch vitally the well-being, health and safety of the people. On the technical competence of those who design and build such works depends the security of the people against flood, epidemic and conflagration.

MOREOVER, the safety of such installations depends on the integrity of a thousand details, all of them affected by the competence of an engineer, the responsibility of a builder, the skill of a foreman, the quality of materials, the workmanship of machinery or equipment and the experience and character of its manufacturer. A caving dam, a batch of porous concrete, a leaky gate, a defective purification device, a cracked main, a broken hydrant stem—any one of these may take a heavy toll of lives by disastrous floods, pollution of water, bursting mains or runaway conflagration. These may well be the penalties—not necessarily today, but sooner or later—of incompetence, irresponsibility and cheapness in the building of certain public works.

Surely such works should not be subject to the hazards of WPA work-relief methods, which sacrifice all else to the making of jobs for those on relief. On them should be no place for workers, drawn promiscuously from relief rolls, for inadequate supervisors selected on political grounds, for a deliberate restriction of the sums available for materials and equipment that must rule out quality and responsibility. The less so because most such projects need be financed only in part through federal aid, and no community should be required to pay for such partial aid so heavy a price in hazard to its people.

ALL THIS should be of urgent concern to the engineering profession, especially to those groups that are responsible for the building and administration of such works. At this juncture it is well within their scope to impress upon those in authority a recognition of the hazards as well as the wastes that would be incidental to such a procedure. It is not too late for our Washington Charles to see that his wise sayings are translated into practical performance.

Willard Chevalier

ENGINEERING NEWS-RECORD

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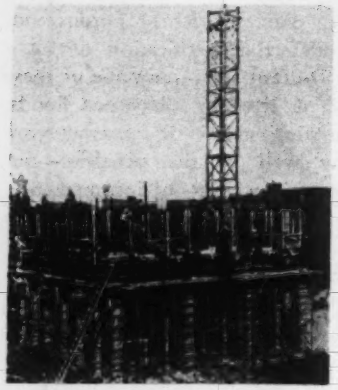
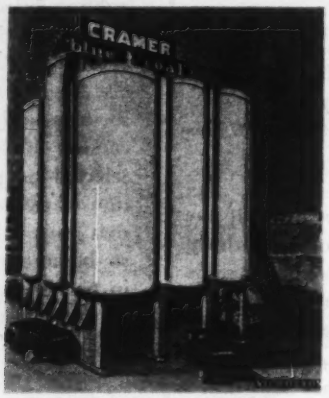
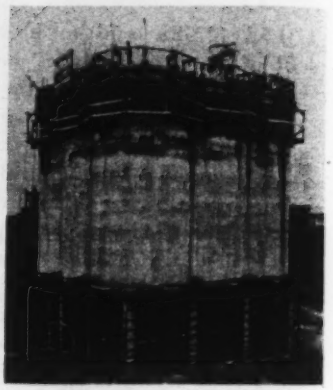


Start August 27—5 P.M.



Finished Construction



Completion August 30—7 P.M.

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In the News:

ORGANIZED LABOR protests against WPA wage scales and demands for "prevailing rates" bore fruit last week when Administrator Harry L. Hopkins authorized a reduction in hours worked per week with no reduction in total pay. Reductions are to be made by state WPA administrators when the 40 hr. week provision is "not feasible or practical."

TENANTS moved into the Techwood housing project in Atlanta last week. First all-federal project to be started, Techwood is the first completed. Initial tenants are students at Georgia Tech, which is just across the street.

A COMPARISON of appropriated sums with estimated total costs for current projects of the Corps of Engineers and the Bureau of Reclamation reveals requirements for over a half billion dollars of new appropriations. The corps will require $400,000,000, the Bureau $250,000,000.

RELIEVED by Uncle Sam's decision to keep the eastern air mail terminus at Newark instead of moving it to New York City's municipal field, Newark authorities received further relief last week from a WPA grant of $3,400,000 for new runways, a drainage system and a new hangar.

CARNEGIE AND ILLINOIS are names familiar to every construction man from long association. Henceforth, however, he will not use Carnegie steel or Illinois steel but Carnegie-Illinois steel. These two subsidiaries of U. S. Steel Corp. have been consolidated.

BIDS WERE CALLED on interceptors for New York's Wards Island sewage plan last Tuesday. Bordering the Upper Manhattan and Bronx waterfronts, the sewers are estimated to cost around $8,500,000.

THE TWENTY-ONE regional offices of the National Labor Relations Board were set up throughout the country last week. A director and an attorney comprise the principal personnel at each.

ATLANTA VOTERS approved a $1,775,000 bond issue last week, to finance their share of the proposed WPA sewage and school program. Federal funds already available total $4,599,000 for 54 miles of trunk sewers, 5 dispoal plants and 10 miles of storm sewers.

THE APPLICATION of Dexter P. Cooper, Inc., for a license for the Passamaquoddy power project has been denied by the Federal Power Commission. The action clears the deck for the federal government to go ahead with its development although Maine's apparent lack of interest in finding a market for the power is reported to have had a cooling effect in Washington.

In This Issue:

NOTABLY HEAVY structural framing characterizes the new municipal auditorium that Kansas City, Mo., will have ready for opening in a week or two. Concrete girders 6 ft. deep and 3 ft. wide carry the arena floor, which is roofed with steel trusses of 226 ft. span weighing 240 tons. There are few buildings that can boast of comparable members and only one that can claim a greater seating capacity.

ROLLED CONCRETE pavements have proved successful in Australia, where mixes as lean as 1:2½:10, in place for 4 years, show a 900 lb. per sq.in. flexural strength. Rolling reduces the voids in the coarse aggregate permitting a reduction of mortar.

AN ECONOMIC COMPARISON between rigid frame foundations and isolated footings for buildings is presented, with claims of advantage for the rigid frame on the score of more uniform settlement.

THE SHORT-LIVED attempt at integration of the construction industry under the code revealed both pitfalls and potentialities. In his concluding article, James W. Follin, who was secretary of the Construction Code Authority, further reviews the experiment and analyzes the possibilities of obtaining the code objectives through voluntary cooperation.

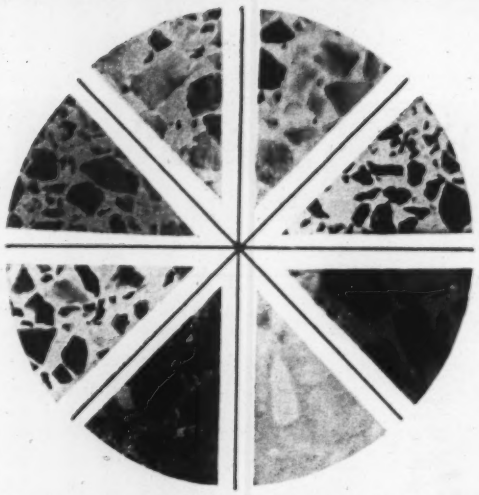
ONE OF THE important centers of hydraulic research in the United States is at Iowa University. In addition to extensive student and graduate work, many project investigations are carried on. Recently the Mississippi River navigation dams and TVA's Pickwick Dam have been the subject of research. Notes on current work are presented by F. T. Mavis, who is in charge of the laboratory.

WATERWORKS MEN met in Providence last week for the annual convention of the New England Water Works Association. WPA construction, with its emphasis on jobs rather than the production of efficient and lasting water facilities, was made the subject of important resolutions. The strong technical session is reviewed in the report of the meeting in this issue.

Coming Articles:

AN IMPORTANT DECISION on valuation procedure was rendered by the U. S. Supreme Court in the case of the Chesapeake & Potomac Telephone Co. vs. The Maryland Public Service Commission. The pros and cons of using price indexes were thoroughly covered, the majority ruling against their use as the sole basis of a valuation. An article abstracting the decision will be published Oct. 10.

Reading counter-clockwise from top: Verdolite, Red Verona, Royal Green and Belgian Black and Red Verona marbles.



Reading clockwise from top: Blue Turquin, Cardiff Green, Red Champlain and Travertine marbles.

COLORFUL! When you think of fine terrazzo its *color* is the first characteristic that comes to mind. Red, blue, green, yellow, vivid and shining. Or perhaps cream, buff, pink, lavender, soft in pastel tints. There are *no* color limitations in fine terrazzo. And more than this, because its design depends entirely on what you need for a particular floor, the pattern itself can emphasize or subdue the colors. These custom-made fine terrazzo floors, however, are made of sterner stuff than their gypsy colors might indicate. They wear like concrete, because they are a form of concrete. They are simple to install, easy to clean, hard to mar, economical to maintain. You'll be interested in what your architect can tell you about fine terrazzo. Or write for details to Universal Atlas Cement Co. *(United States Steel Corporation Subsidiary)*, 208 South La Salle Street, Chicago.

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Fine terrazzo floor, photographed in natural color, installed in Los Angeles County General Hospital. Made with Atlas White portland cement. Venetian Terrazzo & Mosaic Company, terrazzo contractor. Allied Architects, architects. Both of Los Angeles. In the color circle above are shown actual-size, true-color terrazzo samples which illustrate marble and pigment combinations similar to those used for this floor.

ATLAS WHITE PORTLAND CEMENT

plain and waterproofed

UNIVERSAL PORTLAND CEMENT

ATLAS PORTLAND CEMENT

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September 26, 1935

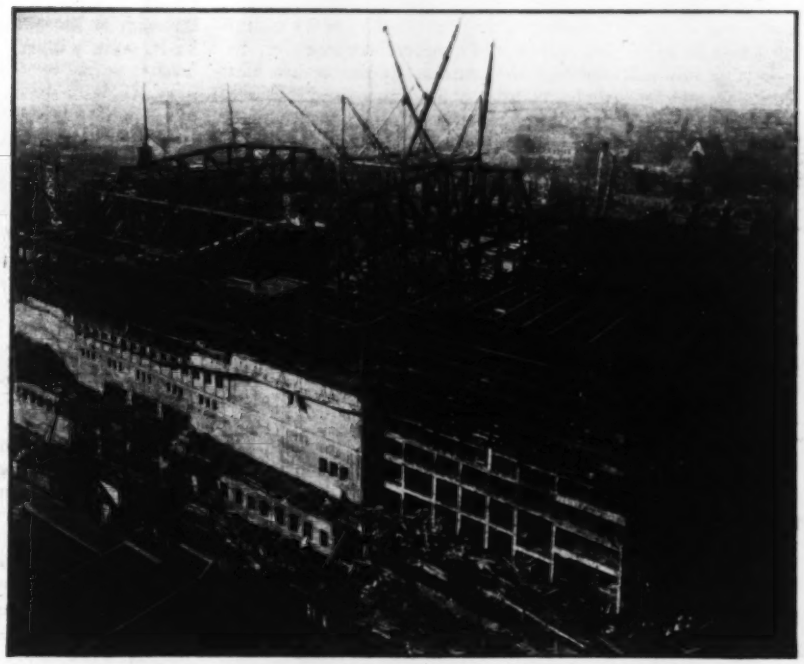


FIG. 1—ROOF-TRUSS ERECTION on the new municipal auditorium at Kansas City. Transverse trusses, which weigh 240 tons each, span 226 ft. and support nine longitudinal trusses of 190-ft. span over the arena. Tier framing of 3,000-seat theater and office wing are in right foreground.

Long Spans in Concrete and Steel for Kansas City Auditorium

Seating 13,000 people around the arena and providing 4 acres of exhibition space on the floor below, the new municipal auditorium at Kansas City, Mo., presents some new records of accomplishment in structural building framing

THE architectural plan for the new Kansas City, Mo., municipal auditorium, which permitted no roof supports in a 225x190-ft. area of arena and no columns under this arena floor in an area of about 85x200 ft., has resulted in a structural layout of commanding interest. Both reinforced concrete and structural steel are involved, notable design elements being long continuous concrete girders 72x30 in. in cross-section, concrete joists of 86-ft. clear span (48 in. deep at the center and 72 in. deep at the ends) and roof framing involving two main trusses of 226-ft. span weighing 240 tons each. The four columns supporting these two heavy trusses carry the entire main roof. Erection of this roof framing with a huge 4-derrick traveler 125 ft. high gave the project a sensational flavor infrequently associated with building operations.

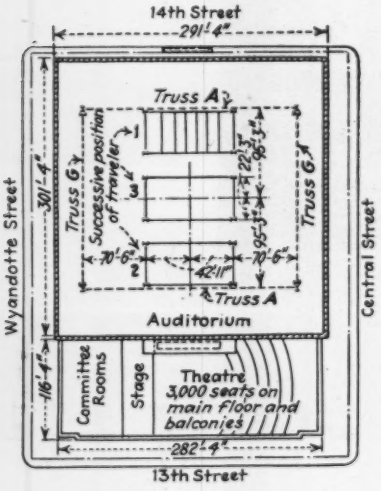
The auditorium, which will be ready for use about Oct. 1, was built at a cost of $4,650,000. Occupying an entire block, bounded by 13th and 14th, Wyandotte and Central Sts., the structure, 426x352 ft. in plan, is made up of two separate buildings—a 3,000-seat theater and a 14,000-seat auditorium. The theater, largely of structural-steel framing and equivalent roughly to a ten-story building, involves complicated details, long-span proscenium trusses and steel cantilever balconies, but is in nearly all respects typical of such structures. Principal structural interest centers in the auditorium, which is exceeded in seating capacity in this country only by the Atlantic City auditorium.

General requirements

In planning the new facilities, the authorities sought to provide a structure that would adequately serve any organization, regardless of size or scope, that might want to hold a convention or industrial exhibit in Kansas City. Facilities for opera, civic entertainments and athletic contests were demanded that would equal those in any other city and would greatly improve upon those available in old Convention Hall, which had

served the city for so many years. Safety from fire or panic, optimum sight lines and acoustics and controlled air conditions were among the other basic requirements. These diverse needs, it was decided, could best be provided by two different types of structure. A plot 116 ft. deep across the north end of the site, therefore, was assigned to a theater (Fig. 2) in which 3,000 persons can be seated for operas and concerts and in which are located three general function rooms accommodating 1,000 persons each and a half-dozen stories of committee rooms for group meetings of a dozen to 400 persons. The remainder of the plot was assigned to a huge auditorium, 301 ft. long and 291 ft. wide, in which the other functions, principally athletic contests, circuses, pageants and industrial exhibits can be accommodated on a large arena floor. In addition, there are provided some four acres of industrial exhibit space on a floor beneath the arena.

FIG. 2—SITE PLAN showing division into an auditorium and a theater; also the several positions of the traveler used to erect the auditorium roof framing.



Safety from fire is achieved by utilizing reinforced-concrete construction to the top of the seats in the auditorium and by fireproofing the steel theater framing; one-way ramp exits are used exclusively. Vision is enhanced by eliminating all columns in the arena portion of the auditorium; the size of the auditorium was largely determined from a careful study of acoustical demands.

Atmospheric conditions are controlled by what is claimed to be the largest single air-conditioning system in the Middle West, having a refrigerating capacity of 1,016 tons and an air-handling capacity of 625,000 cu.ft. per minute.

The auditorium plan

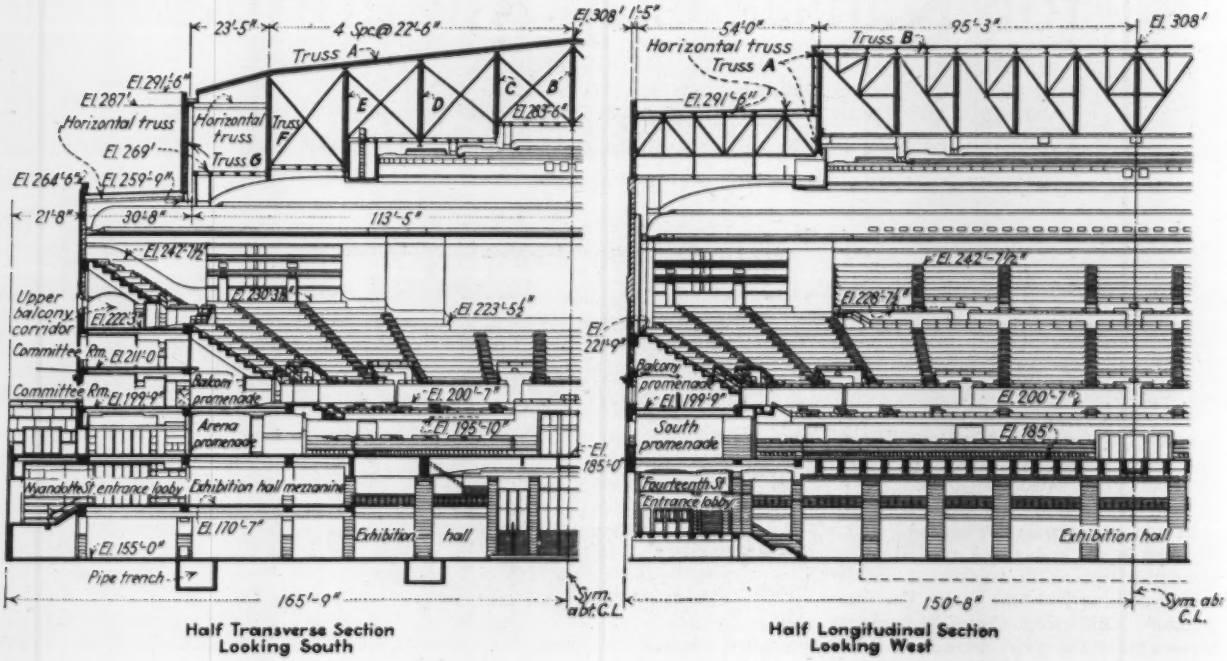
In effect, the auditorium is a concrete stadium covered with a steel-framed roof, the walls being enclosed in a buff-colored Indiana limestone. As shown in Fig. 3, the auditorium is made up of a basement or exhibit floor, an arena floor surrounded by seats and access promenades, and a roof the central main portion of which is inside a narrow peripheral roof at a 30-ft. lower level.

The basement covers the entire area, 300x430 ft., and is at El. 155, which is from 10 to 20 ft. below the streets since the building is on a hill sloping south from 13th St. This area was excavated to grade by hand labor as a relief project. Foundations were then contracted, with piers for the majority of the columns being sunk from a few feet to 35 ft. below general excavation level in order to reach rock, a limestone formation known as the Calico Ledge, which is 7 to 9 ft. thick.

The exhibit-hall space, with a 30-ft. ceiling height over the central 85x200-ft. area, is surrounded by a mezzanine 55 ft. wide with a 15-ft. ceiling height. The framing of this exhibit-hall ceiling, which is the floor of the arena, is of extremely heavy beam and joist construction in reinforced concrete. The arena, at El. 185, is reached by ramps from the street level. The oval-shaped arena floor is 128 ft. wide and 200 ft. long, surrounded by boxes at floor level backed up by an arena promenade, above which there are four tiers of balcony seats separated from the main auditorium seats by a balcony promenade. The seats extend upward to El. 243 and entirely encircle the arena. In each corner is located a series of ramps for easy access to all parts of the auditorium. During construction the contractor made efficient use of these ramps by hauling his materials in trucks up to any required location.

The structural plan upon which the roof framing is based involves the use of two-column groups at each corner of the main roof, arranged to support the four principal roof trusses, which outline an area 226 ft. wide and 190 ft. long. Each of the column groups is incorporated in a braced steel tower 30x85 ft. in plan, which extends from basement to roof; these towers form the corners of the auditorium and serve as

FIG. 3—SECTIONS of the reinforced-concrete auditorium roofed over with an extensive system of heavy steel trusses supported outside the sight lines of 13,000 arena seats.



buttresses in steadying the tall, heavily loaded columns under lateral loads. The transverse trusses at either end of the arena floor, A trusses, of 226-ft. span, carry the nine longitudinal roof trusses of 190-ft. span on which are placed the purlins and a 1¾-in. pressed-steel-plate deck welded to the purlins. The main longitudinal trusses along either side of the arena, G trusses, of 187-ft. span, carry a portion of the peripheral roof but are principally loaded with a 12-in.-thick exterior wall 30 ft. high; they are carried on columns separate from but immediately adjacent to those that support the A trusses.

The live loads used in the design are as follows: arena floor, 125 lb.; ramps and stairs, 100 lb.; balconies, 50 lb. per sq.ft. For the entire structure, auditorium and theater, 28,000 cu.yd. of concrete, 1,750 tons of reinforcing steel and 5,300 tons of structural steel were required.

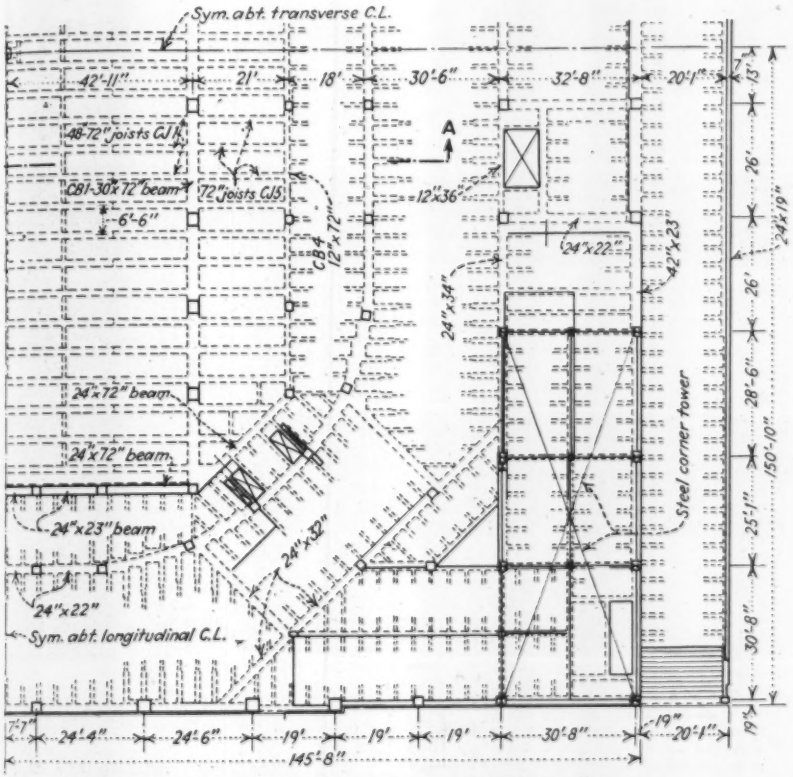
Heavy concrete girders

The longitudinal concrete girders and the transverse concrete joists that roof over the exhibit basement and support the arena floor are worthy of note as being among the largest ever used in building work. As shown in Fig. 4, the two main longitudinal girders (CB1) are 86 ft. apart. Continuous over concrete columns on 26-ft. centers, the girders are 72 in. deep and 30 in. wide and support the three-span transverse joists, which are spaced on 6½-ft. centers. These joists also are of substantial section, and continuous, the 21-ft. side spans being 72 in. deep and the 86-ft. center spans 48 in. deep, tapering in a length of 18 ft. at either end to a 72-in. depth at the girder support. The joists are 18 in. wide, and 30 of them are required. The fixed end moments in these and adjacent joists were distributed among all connecting members for all conditions of loading.

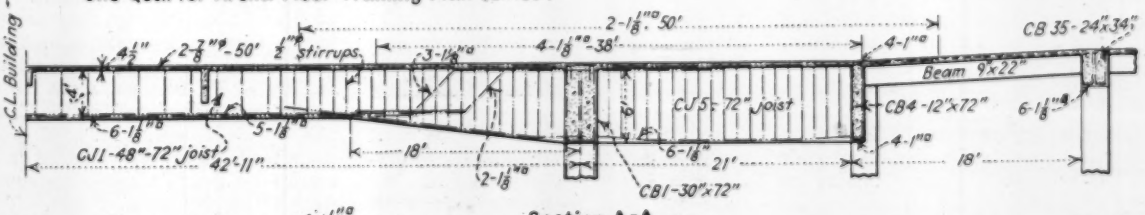
The joists and the girders were poured integrally with the 4½-in. slab that comprises the arena floor. A 1:2:3 mix concrete was used for the girder and joist system, whereas a 1:2:4 mix was used elsewhere. Vibrators were very successfully used in the pouring of all concrete in the arena portion. The girder and joist reinforcing consists of 1⅛-in. square bars and ½-in.-diameter stirrups.

All concrete columns are square or rectangular. The main columns, which carry the arena girders, are 36x30 in. in section and reinforced with 32 bars (1¼ in. square) and ⅜-in.-diameter ties. The reinforcing was arranged in such a way that the columns would be especially effective in resisting their share of the bending from the arena floor; the column section was proportioned for both vertical and bending loads.

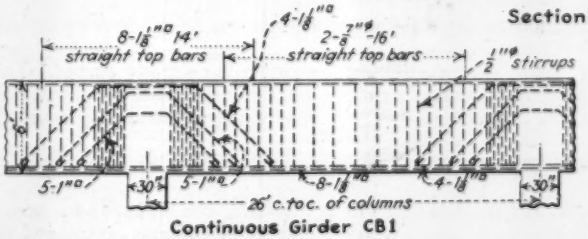
The concrete framing elsewhere in the auditorium is not unusual. Floor joists are in general 22 in. deep, built with 18-in. wood-pan forms under a 4-in. slab floor. Ramp floors were built with 12-in. pans under a 4-in. slab. Cantilever girders 15 ft. long occur in the first balcony. In their design the moments were figured about the point of support, and the necessary resisting moment was divided among the columns, the floor construction and seat ramp



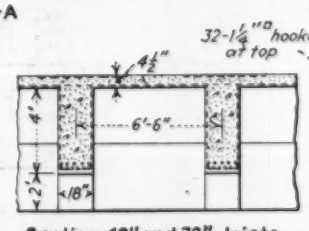
One Quarter Arena Floor Framing Plan (El. 185')



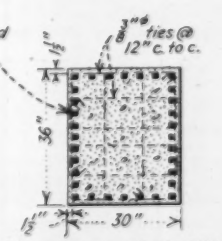
Section A-A



Continuous Girder CB1



Section 48" and 72" Joists, CJ1 and CJ5



Column Under Girder CB1

FIG. 4—ARENA-FLOOR FRAMING of Kansas City municipal auditorium contains some of the heaviest concrete girders and beams yet used in building work.

girders. In all of the concrete design an attempt was made to keep the joist and beam bottoms flush, compensating for differences in moments and shears by adjusting the relative amounts of reinforcing steel. The practice of making joist and beam bottoms flush contributed markedly to economy in formwork.

Roof framing

The total roof area, 291x301 ft., is composed of the central main roof, 226 ft. wide (east and west) and 190 ft. long, surrounded at a 30-ft. lower level by strips of roof 31 ft. wide on the sides and 55 ft. wide on the ends. The central 226x190-ft. rectangle is framed with an extensive system of trusses (Fig. 6), all carried on only four columns, one at each corner. The side strips are framed with 15-in. and 24-in. wide-flange beams, whose inner ends are carried by a 187-ft.-span longitudinal truss (G), which is supported by columns adjacent to the four main corner columns, while the outer ends rest on longitudinal beams carried by short steel wall columns rising from the level of the top of seats (El. 243). The end strips of roof are framed with trusses of 55-ft. span (H, I, J and K), whose outer ends are likewise carried by beams resting on short wall columns but whose inner ends frame into the 226-ft.-span main trusses.

The two 226-ft.-span trusses (A) at either end of the arena are the primary load-carrying elements of the roof system. Between them frame nine longitudinal trusses of 190-ft. span (B, C, D, E and F), which support the transverse braces and longitudinal channel purlins that carry the 18-gage copper-bearing steel roof deck.

The main roof system, made up of transverse trusses A and longitudinal trusses B, C, D, E and F, is entirely separate from the surrounding lower roof (Fig. 6), and provisions are made for its movement as a unit from temperature or live loads. Transversely, this movement is by bending in the long steel columns that support the A trusses. Lengthwise movement is provided by bending in the A trusses, whose connection to the trusses behind them in the end roof strips is by means of slotted-hole pin joints.

An extensive system of horizontal trusses is used on all roof levels, to provide for lateral forces acting on the walls and roof, including both direct wind load and suction on the lee walls. All horizontal-truss reactions are transmitted to the four corner towers, through which they are carried to rock by means of vertical X-bracing.

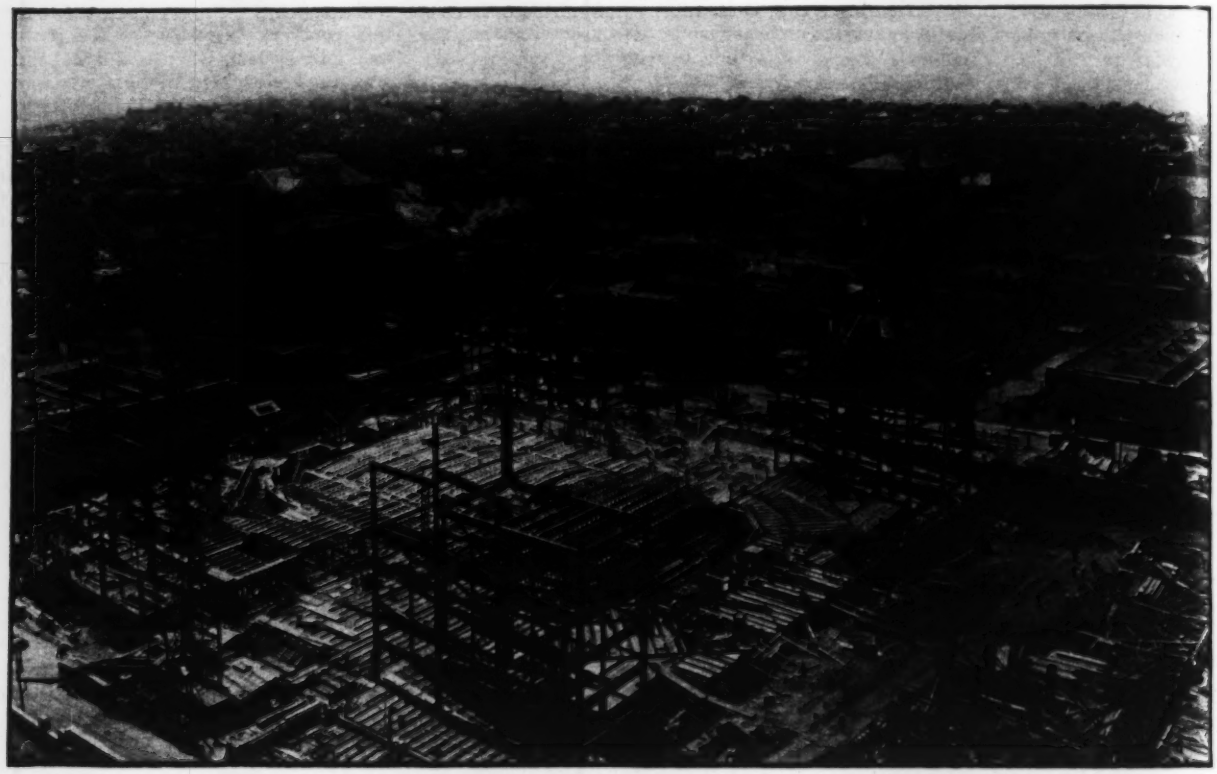


FIG. 5—CONCRETING OPERATIONS under way on the arena floor. The four steel towers in the corners of the arena serve as braces for the 226x190-ft. roof that is carried on the four columns that may be seen extending above the tops of these towers.

Roof trusses

The 226-ft.-span A trusses weigh 240 tons each, making them among the heaviest ever used in building construction; the only heavier trusses are in the Radio City Music Hall, New York, 300 tons and 110-ft. span; the Ambassador Theater, St. Louis, 277 tons and 120-ft. span; and the Stevens Hotel, Chicago, 240 tons and 86-ft. span. The A trusses are 30 ft. deep, with curved top and bottom chords of built-up H sections of silicon steel, which are subjected to maximum compressive and tensile stresses of 3,460,000 and 3,300,000 lb. respectively (in the middle panels). Analysis of these trusses indicated secondary stresses as high as 55 per cent, so that in their design the primary stresses were rather radically reduced. The dimensions and sections are shown in Fig. 6.

The other heavy trusses are those labeled G, which outline the edges of the main roof area although they are structurally separate from the main roof itself. The G trusses weigh 100 tons each and are of 187-ft. span, about the same as the longitudinal trusses, B, C, D, E and F, which weigh only 30 tons; a stone wall, 12 in. thick and 30 ft. high carried by the G trusses, accounts for their disproportionate weight. The G trusses are 28 ft. deep at the ends and 27 ft. deep at the center, the lower chord being slightly curved. The other longitudinal trusses are 30 ft. deep with subdivided panels and parallel chords.

Main roof columns

Within the 291x301-ft. arena area, only eight columns occur, and they are in pairs at the four corners of the main

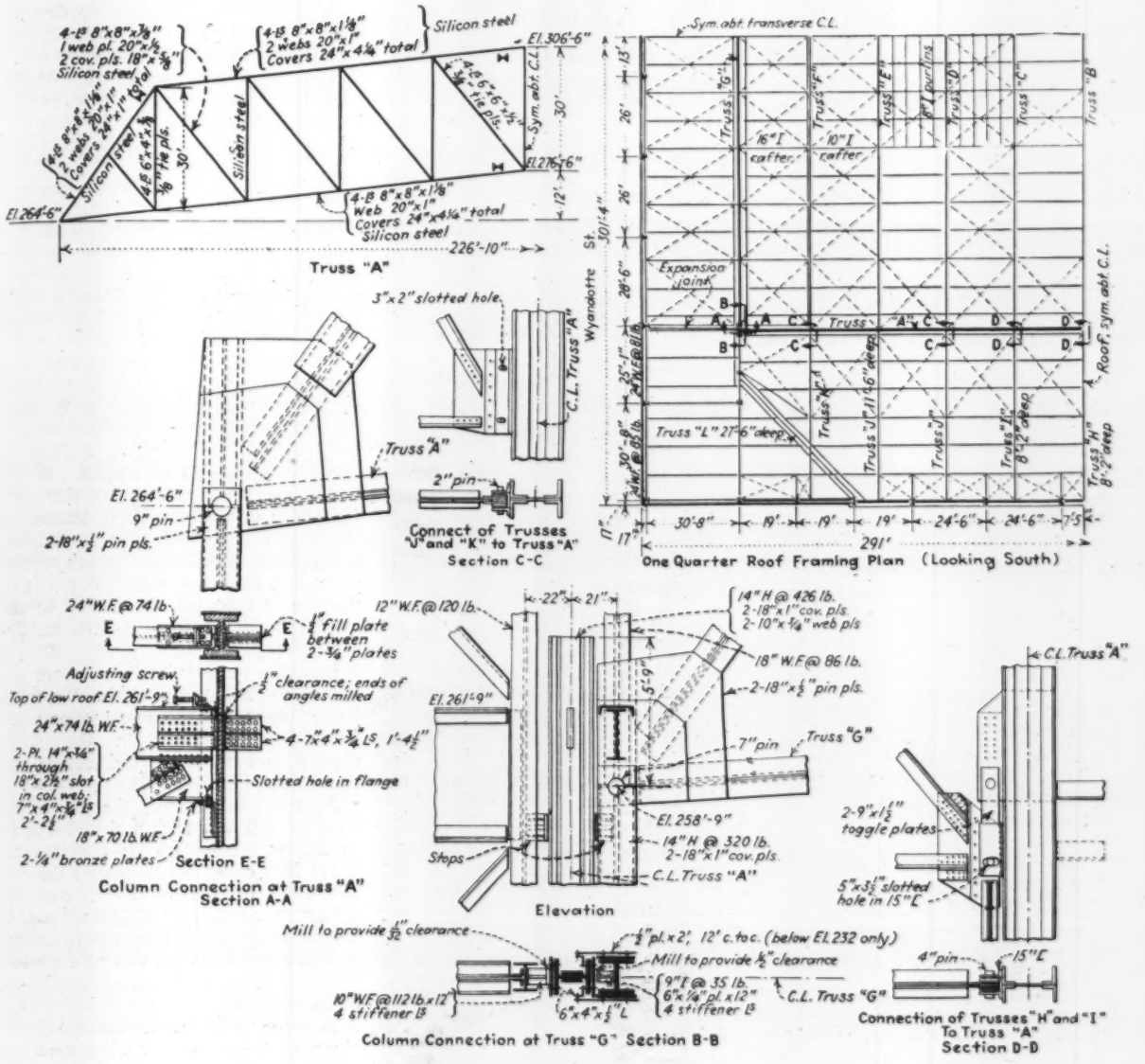


FIG. 6—ROOF PLAN and details of main trusses and connections.

roof section. Four of these columns carry the longitudinal G trusses, while the other four are under the ends of the A trusses. The eight columns are over 100 ft. high and are carried on four piers, which are founded on a limestone ledge at about El. 114.

The adjacent columns for the A and G trusses are set at right angles to one another, with the truss framing into the web in each case. Below El. 233 (about the top of the side arena seats) the two columns are tied together by 24x½-in. plates on 12-ft. centers vertically. Above this elevation the columns are free-standing (30 ft. for the truss A columns and 25 ft. for the truss G columns), to allow bending from transverse loads. The A-truss column, supporting a load of 3,900,000 lb., is a 14-in., 426-lb. H-section with 18x1-in. flange plates and 10x¾-in. web plates. A 14-in., 320-lb. H-section and 18x1-in. flange plates comprise the G-truss column. Both trusses are pin-connected to the columns, a 9-in. pin being used in one case and a 7-in. pin in the other. As previously stated, the columns are integral parts of the structural-steel towers.

Inasmuch as the A-truss columns, in bending under lateral loads acting at right angles to the A truss, will move toward the G-truss columns, some means is necessary to control and limit this movement. This is accomplished by the detail shown in Fig. 6. A 9-in., 35-lb. I-stub stiffened with four angles is riveted to the web of the G-truss column, and the outer flange is milled to provide ½-in. clearance. A similar detail on the opposite side of the A-truss column is connected to the framing of the tower and provides for ½-in. movement in that direction.

Movement of the A-truss column in the plane of the A truss (at right angles to the G truss) is permitted by another detail, also shown in Fig. 6. Here the framing connection of the adjacent low roof strip is made by a plate passing through a slot in the web of the A truss. Angles attached to this plate either side of the web furnish stops that limit the movement of the column to ½ in. either way from vertical. On the same illustration is given a sketch of the detail developed by the steel erector, to adjust the position of the A-truss column to the temperature existing at the time the field connection of the slot-hole plate was made. The adjusting screw, it will be noted, is attached to the low roof framing and acts against the web of the A-truss column. After the adjustments were completed, the screw was run back, and the detail was left in place for possible future use.

Roof-truss erection

The necessity for erecting 1,000 tons of roof trusses over an area 226 ft.

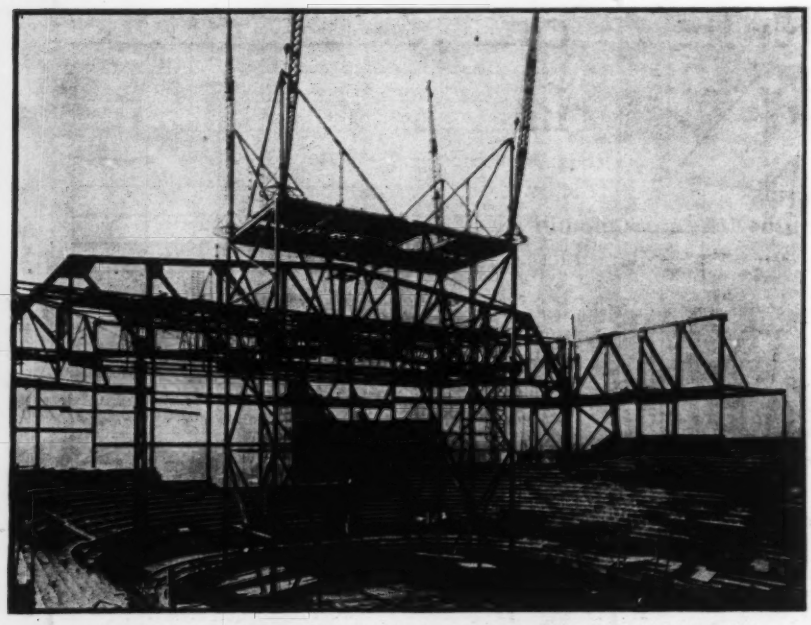


FIG. 7—FOUR-DERRICK TRAVELER, 125 ft. high and weighing 160 tons, with which the roof trusses were erected.

wide and 190 ft. long in which there were column supports only at the corners presented unusual hazards and difficulties. Falsework nearly 100 ft. high above the arena floor was required because none of the thirteen trusses involved could be erected in one piece. Furthermore, derricks would have to be set at an even higher level if they were to clear the steelwork and be in a position for most efficient use. After study of a number of schemes, a solution was worked out whereby falsework and derrick support were combined in a single 125-ft. tower that could be moved from one end of the arena to the other. This tower was made 86 ft. wide and 52 ft. long; such a width brought its load to the floor directly over the 36x72-in. longitudinal concrete beams (CB1), while the length was fixed by requirements for stability of the tower itself.

The tower was provided with three platforms. On the lower platform, some 3 ft. above the arena floor, 100-hp. electric hoists were mounted in each corner, to serve four steel stiff-leg derricks mounted on the top platform 125 ft. above. The third platform was placed at an intermediate level about 100 ft. above the floor, to serve as a falsework support for the trusses. Diagonal bracing between the two top platforms was designed to clear the truss members as they were erected. Completely equipped the tower traveler weighed 160 tons.

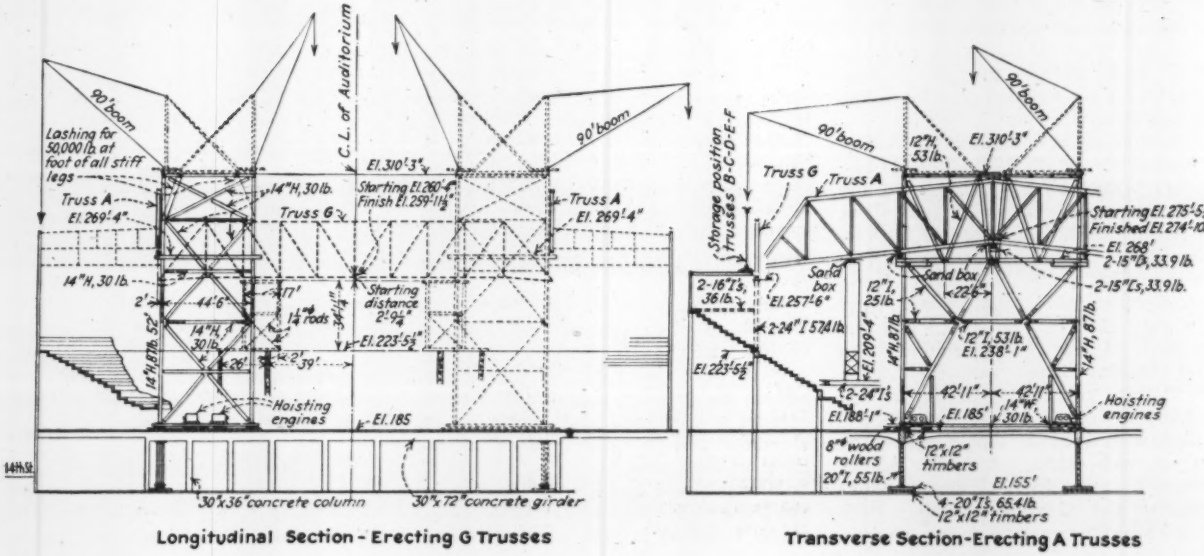
The general plan of operation was to erect the A and G trusses first, outlining the rectangle, and then to fill in the longitudinal trusses B, C, D, E and F. The traveler, assembled by a 130-ft. boom guy derrick, was first placed in front of the A truss at the south end of the arena. Erecting this truss and the first four panels of the G trusses on either side, it was then moved the length of the arena floor on 8-in.-diameter wood rollers. At the north end of the arena the procedure was repeated on the A and G trusses. The traveler then was moved back to the transverse center line of the auditorium, where it filled in the center two panels of the G trusses and erected the nine longitudinal trusses that frame into the A trusses. While in the end positions the traveler derricks also erected the short trusses of the low roof outside the A trusses. Moving the traveler the length of the arena and half way back thus put it in position to erect all of the steel in the building with its four 90-ft.-boom 20-ton stiff-leg derricks.

Both the A and G trusses were required to be erected from the pins toward the center. These trusses were sub-drilled assembled in the shop, reamed and match-marked before delivery to the job.

As previously noted, the A trusses weighed 240 tons each and had a span of 226 ft. Inasmuch as the traveler tower legs could not be placed directly over one of the 30x36-in. concrete columns that carry the arena floor, it was necessary in erecting the A trusses to shore the 30x72-in. concrete girders with a column made up of two 20-in. 50-lb. I-sections.

Five points of support for the lower chord of the A trusses were required. Three of these were provided by the tower traveler, and two-column steel

FIG. 8—ERECTION PLAN for auditorium roof trusses, using a movable tower traveler equipped with four 20-ton derricks with 90-ft. booms.



bents 60 ft. high were blocked up from the arena seats on either side of the tower, as shown in Fig. 8. Steel was trucked into the building and onto the arena floor, whence it was lifted directly into place. The lower chords were erected in three pieces, the upper chords in five pieces. The heaviest single lifts were the end pieces of the bottom chord, which weighed 18½ tons each. End posts and outside top-chord pieces weighed 15 tons each.

The A trusses at the points of falsework support were carried on sand jacks of ingenious design, which permitted the trusses to be swung free with a minimum of trouble. Each jack consisted of a sand box 1 ft. wide, 1 ft. high, and 2 ft. 8⅛ in. long, into which was inserted a plunger 2 ft. 8 in. long, made of a 12-in. 65-lb. H-section with stiffener plates between the flanges. The bottom plate of the box was made 22 in. wide (5 in. wider than the sides of the box on either side), to provide a support for stiffener plates attached to the sides of the box. The entire assembly was arc-welded. Three plugged holes in either side of the box near the bottom permitted the sand to run out. In swinging the trusses they were lowered a total distance of about 8 in.

Longitudinal Truss Erection — The four panels at either end of the G trusses were erected with the traveler in the same position as it was for the A trusses. A steel falsework bent with columns under panel points 2 and 3 was used in each case, as shown in Fig. 7. These trusses weighed 90 tons each, so that these end panels weighed about 35 tons. The center two panels, involving some 20 tons of steel, were placed after the traveler had been moved to the center of the arena floor.

Erection of the nine trusses that span 190 ft. lengthwise of the arena and frame into the A trusses was a relatively simple operation. They weighed only 30 tons each and were assembled in halves on the arena floor and lifted directly into place, being supported on the traveler at their center point where the splice was made.

Personnel

The Kansas City municipal auditorium was built by the city public works department of Kansas City, Mo., Matthew S. Murray, director and chief engineer. The architects were the associated firms of Alonzo H. Gentry, Voskamp & Neville, and Hoit, Price & Barnes, of Kansas City. The structural design was made by Erwin Pfuhl, consulting engineer, Kansas City, assisted by Alfred Masterson.

Patti Fleischer, Ring Engineering Construction Co., Kansas City, was the general contractor. The Kansas City Structural Steel Co., A. M. Meyers, chief engineer, and Thomas McCurnin, superintendent, fabricated and erected the structural steel.

Rolled Concrete Pavements in Victoria, Australia

Using mixtures as lean as 1:2½:10, excellent finish and high moduli of rupture are being secured in regular practice by roller compaction

By M. G. Dempster
Engineer for Bridges, Country Roads Board, Victoria, Australia

RECENT experience of the country roads board of the state of Victoria, Australia, indicates the excellent possibilities of roller-compacted concrete pavements. Prior to 1934 concrete-pavement construction followed usual practices, using a 1:2:4 mixture. However, early in 1929, the problem of developing a satisfactory concrete road that would combine the advantages of the established methods (which provide for a well-graded sand, a high-strength mortar and a relatively low water-cement ratio) with some mechanical process for reducing the voids in coarse aggregate and thereby allowing a considerable reduction in mortar, was given considerable thought.

It was argued by those in favor that if the voids in loose coarse aggregate were 50 per cent and if coarse aggregate could be compacted under a roller from 4 in. loose to 3 in. consolidated thickness, the voids in the coarse aggregate and therefore the mortar content required for a concrete road could be reduced by about 50 per cent. As a straight deduction from the use of a 1:2:4 mix, it should be logical therefore, to mix a 1:2:8 concrete and spread it on the subgrade, and subsequently roll it until the coarse aggregate was so consolidated that the greatly reduced quantity of mortar would be sufficient to fill the voids completely.

FIG. 1—CONCRETE first was dumped from a truck onto spreading sheets and shoveled into slab; rolling followed a templet strike-off of the surface.

Exploratory experiments

The first experiment was made in May, 1929, when a few square yards of this mix were put down and rolled with an 8-ton roller. The experiment confirmed the conclusions reached in the analysis, and a few weeks later a further section 50 ft. long by 12 ft. wide was constructed, to ascertain whether it was better to use a grading comparable to that shown on Fuller's curve for the coarse aggregate or to use a grading in which coarse aggregate from ¼ in. to 1 in. was excluded. This experiment indicated that the graded aggregate was better for ease of consolidation and ease of finishing than the aggregate without the fines. This section was consolidated

with a roller weighing 12 tons, and in spite of the fact that the work was done in the middle of winter when the air temperature ranged from 35 to 45 deg. F. the modulus of rupture of three beams was 460, 417 and 434 lb. per sq. in. at 28 days. It would appear from these tests that if the temperature during the curing period had been comparable with summer conditions, the strength of these beams would have been at least 600 lb. per sq. in. The mix used was 1:2½:10.

Following the second experiment, 800 ft. of road over a floodway section on one of the state highways was constructed by this process. In this work, experiments were made with several types of aggregates and with various proportions. The following mixes were used: 1:2:8, 1:2:10 and 1:2½:10. The sand throughout was the same, but the coarse aggregate for one series was crushed granite, and in another series it consisted of screened quartz gravel. A mixture of quartz gravel and crushed granite was also used. The pavement was 20 ft. wide, and a consolidated depth of 7 in. of concrete was to be placed. A 12-ton steam roller was used, and the concrete was mixed in a 22-cu. ft. paver. The type of roller used, which had about three-quarters of the weight on the rear wheels (which were only 15 in. wide), was not the best for this type of construction. It was noted that the relatively broad front wheel pushed down the 9-in. depth of loose concrete to 7½ in. with one traverse; but when the rear wheels came onto this concrete, furrows were put into the concrete, and at the edges the form boards were pushed out sideways. Consequently, the concrete had to be rolled for two or three hours before it consisted of a sufficiently tight mass free of voids.

Six beams were cut from these sections and gave extraordinarily uniform results, the lowest being 598 lb. per sq. in. and the highest 652 lb. per sq. in. at 28 days. It was shown that the 1:2:10 mix was getting up toward the upper limit of complete consolidation, but the other mixes were reasonably satisfactory. The next work done was the widening of a 15-ft. pavement to 20 ft. by concrete edges on each side. A 7-in. consolidated thickness was placed in these areas, using a mix of 1:2½:10.

Building a three-mile road

The scope for concrete road construction for several years during the depression period was not great. By the middle of 1934, however, a three-mile road was to be constructed with a concrete base, and in view of the successes achieved by the method described above this method was favorably considered. To check up the characteristics of work already done, several beams were cut from the widening trenches of the four-year-old job and when tested in flexure, gave consistent strengths of 900 lb. per sq. in. This showed that the process was fundamentally sound for the construction of concrete pavements. The cost data from all these experiments were few, but it appeared that the process was economical.

There was no difficulty in writing a specification for the three-mile length required, and this was done and tenders advertised and accepted. The mix specified was 1:2½:10, and the work was done over the summer. The plant required was found to be very simple; the contractor used only a half-yard concrete mixer together with a four-ton roller for mixing and consolidating the concrete.

During the first day hot winds caused considerable trouble, and the contractor endeavored to overcome the evaporation by using more water. The effect of this was to give a very fluid mortar, so that when the concrete was dumped onto the spreading plates, the mortar ran away from the coarse aggregate and the segregation was very bad. When this concrete was rolled, half the area had more mortar than was required, and the remainder of the area did not have sufficient mortar. This was overcome by reducing the water used until the mortar adhered to the stones. This corresponded to a water-cement ratio of 0.85. The subgrade was carefully rolled and then sprayed with water until it was in a slightly damp condition, so that it would not absorb moisture from the deposited concrete, but it was not so wet that it would give off water into the concrete above.

No trouble was experienced in producing a completely consolidated road with a relatively small amount of rolling. With such a small mortar content, the effect of the least tendency to segregate in placing is apparent, and some areas had a slight excess of mortar on the surface after two or three traverses of the roller, while other areas showed the mortar about 1 in. below the top of the stone. This was overcome by a man with a broom redistributing the excess mortar. The road was 30 ft. wide. The edge thickness was 7 in., and that in the center was 5 in.

Subsequently, test beams were cut from the section, and the results of the tests are given in the table. The beams of concrete taken from road slabs were tested in cross-breaking with central loading. They were tested first in the same position as in the road, with the bottom in tension, and then, in all bases but one, another test was made with the beam on its side. Though the ratio of span to depth was as low as 2.8 in some cases, there was no sign of shear failure. The load was applied direct to plaster pads or to the beams themselves without any intermediate steel plates.

The rolled construction, which is still relatively new, is being used in New Zealand, New South Wales and to a certain extent in some of the municipalities. The original idea was developed by Caleb C. Roberts, highway engineer, in conjunction with the writer.

FIG. 2—ROLLING SPREAD CONCRETE. In the background exuded excess mortar is spread with a broom and followed with a finishing templet.

UNIVERSITY OF MELBOURNE TESTS OF CONCRETE ROAD SLABS

Beam No.	Position	Span In.	Width, In.	Depth, In.	Max. Load, Tons	Mod. of Rupture Lb./Sq.In.
1	As cast	22	7¼	5.5	1.95	615
1	Side	22	6.2	7.7	2.74	550
2	As cast	22	7¼	6.5	2.29	515
2	Side	21	6.2	7.8	2.74	515
3	Side	22	6.0	7.8	2.58	515
5	As cast	22	7¼	5¼	2.01	580

Notes: In almost every case some stones had broken in the fractured face.

Economics of Rigid Frames for Building Foundations

Comparative design and cost analyses of pile and rigid-frame foundations for a steel-frame office building on deep clay soil

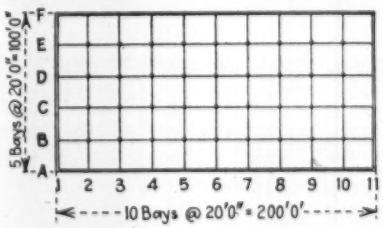
By Kimball R. Garland
Newton, Mass.

DURING the last few years much attention has been given to unequal settlement in buildings resting on compressible soils. Such settlement has occurred in many buildings for which the foundations were properly designed, according to good present-day practice, and in many cases serious damage to the structure has resulted. The unequal settlement has also entirely changed the assumptions on which the superstructures were designed, it being customarily assumed that foundations are level and will always remain so, and the members in the superstructure are carefully proportioned to a nicety on this assumption. As time goes on, the stresses throughout the entire frame may depart farther and farther from the calculated ones due to settlement; one needs only to compute the stresses in transverse girders resulting from a 3-in. differential settlement across a 100-ft. building to realize this fact.

The writer became interested in this subject from the standpoint of the structural engineer and decided to make a comparative design and estimate of the cost of two building foundations on a thick bed of compressible clay—one supported on piles in the usual manner, the other consisting of a rigid-frame structure, resting directly on the clay, designed to resist unequal settlements. Such rigid foundations have already been used occasionally. An outstanding example of this type is the Albany Telephone Building, which was described in *Engineering News-Record*, Nov. 27, 1930.

The writer proposes to show that for large buildings, under the conditions described above, the rigid frame, while somewhat more expensive than the floating-pile foundation, would justify the extra cost by its safety against unequal settlement.

FIG. 1—DIAGRAM column and panel plan of building selected for foundation analysis.



The comparative designs

For the purposes of this study a fairly large, heavy type of building was chosen, to see how large a foundation could practicably be made rigid in this way. If the cost of such a type can be shown to be as economical, or nearly as economical, as the conventional type of pile foundation for such a large building, then for lighter loads and for smaller areas the rigid foundation would be considerably more economical than the pile foundation.

A building was chosen, 200 ft. (or ten bays) long, and 100 ft. (or five bays) wide, as shown in Fig. 1; it was eighteen stories high, with an office loading. Interior column loads were estimated at 1,000,000 lb. each, side columns at 667,000 lb., and corner columns at 405,000 lb. above the first floor. In the office building the reduced live load is very small compared to the dead, and the effect of loading over part of the area can be disregarded for the purpose of this analysis.

The average load of the building, including the basement, is 3,665 lb. per sq.ft. It was assumed that permanent water level, as shown in Fig. 2, is 12 ft. below the surface, and that it would not be economical to excavate the basement much below this level. The resulting net additional pressure on the soil could, therefore, be reduced by about 1,200 lb., leaving 2,465 lb. per sq.ft., which would still be sufficient to cause large unequal settlements.

Pile Design—For this building a complete design of a conventional foundation was made, assuming hard pine piles 50 ft. long, spaced 2½ ft. on centers, with a bearing capacity of 15 tons each. Pile cutoffs were assumed at water level for exterior wall footings, and slightly below for interior footings. One side and one end of the foundation were allowed to project beyond the building line; the other side and end were not but were balanced on combined footings. A light self-supporting slab was designed, supported on filler walls, to span between footings. The first floor was designed as a girderless slab. No attempt was made in this design to obtain rigidity.

Rigid Design—The foundation was then designed as a rigid structure, reinforced to resist the extreme variations of pressure distribution. The side and end walls were designed to take their proportional share of the bending. A system of longitudinal and transverse Vierendeel trusses seemed to be the logical type of design for the interior bents, excavating the basement beams or chord members below the basement floor so as to leave the basement unobstructed. This type of design was used in the Albany Telephone Building; but in the latter the trusses were two stories in height, and the bottom chords were made as one heavy slab rather than as individual members. In the building we are considering, the first floor was then changed into a system of two-way slabs supported on four edges, and the basement became a system of heavy inverted two-way slabs, spanning between girders and carrying the uplift from the soil pressure to the girders and columns. As the interior columns carry both transverse and longitudinal bending, they were made octagonal, rather than square, with brackets about the bases. Circular columns of the same cross-sectional area might prove more economical. To reduce the chord stresses, the basement height was increased to 17 ft. floor to floor.

As an approach to the solution, several trial sections of Vierendeel trusses were solved by the Hardy Cross method of moment distribution, in order to ascertain as nearly as possible what dis-

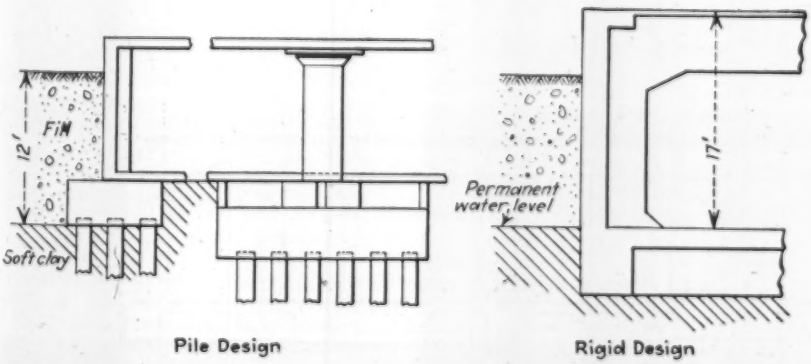


FIG. 2—DIAGRAM SECTIONS showing general type of pile and rigid-frame foundation structure.

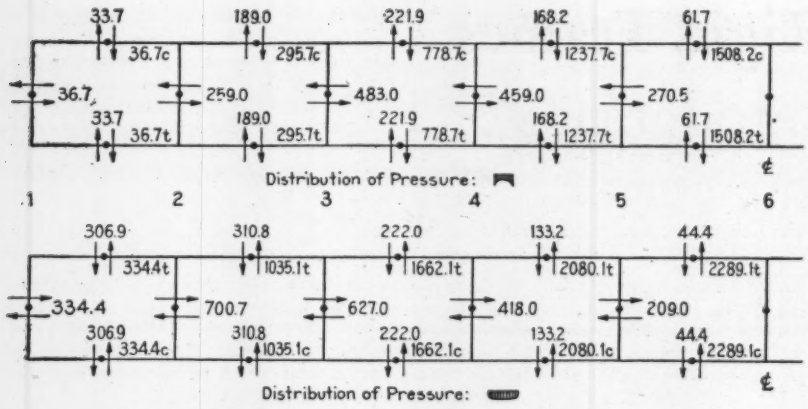
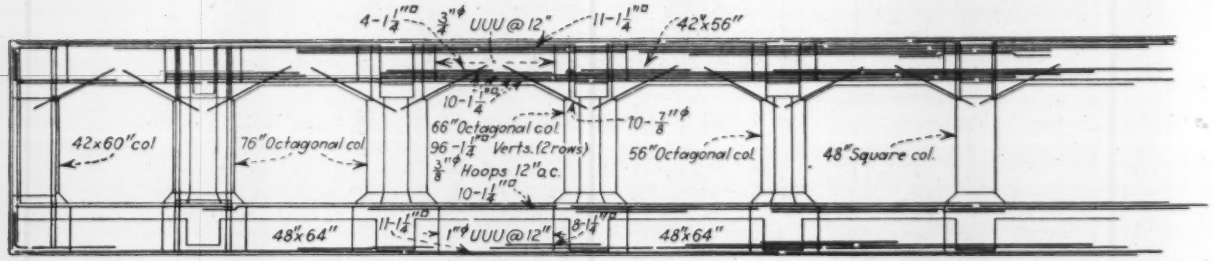


FIG. 3—STRESS DIAGRAMS of longitudinal bent of rigid-frame foundation.

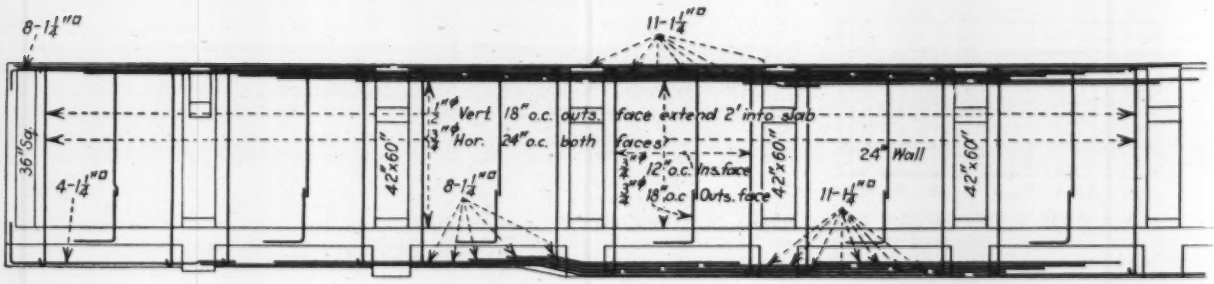
tribution of moments might be expected in such frames. It was found that, provided the top and bottom chords of each panel were of nearly the same stiffness ratio, the points of inflection of vertical and horizontal members were not far from the mid-points of the members; but if the bottom chords were made much stiffer than the corresponding top chords, then the points of inflection of vertical members were raised considerably above the mid-points. Considering the uncertainties as to the exact distribution of soil pressure and the true amount of inertia of reinforced-concrete sections, it seems sufficiently accurate to assume points of inflection in members of the trusses at their mid-points, provided top and bottom chords are made of nearly equal stiffness. While bottom-chord members are somewhat stiffer than the corresponding top chords in the same panels, the difference is not great enough to affect this assumption seriously.

From a study of the deflections of longitudinal and transverse frames, the conclusion was reached that, in this particular foundation, the two side walls carried about 10 per cent less, and the two middle interior bents C and D carried 10 per cent more of the total longitudinal bending, than did bents B and E; and the frames were designed in accordance with this conclusion.

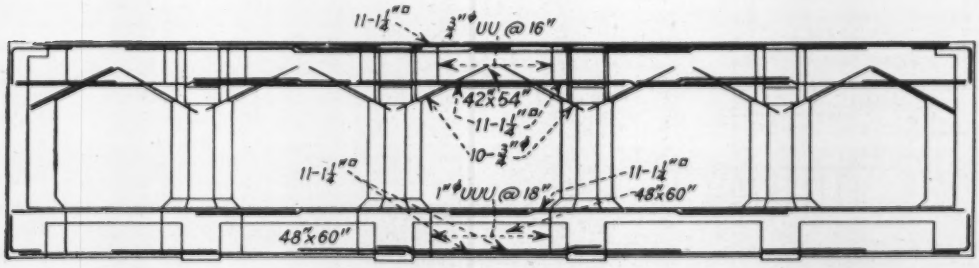
FIG. 4—DETAILS of bents of reinforced-concrete rigid-frame foundation. Full details of the reinforcing are not shown, but its character is indicated.



Half Elevation on C Line



Half Elevation of Side Wall



Elevation on 4th Line

Once these assumptions are decided on, the design is comparatively simple. Knowing the column loads, having assumed the limiting distributions of earth pressure, and having approximated the ratio in which the four longitudinal trusses and the two side walls share the bending, the shears in both longitudinal and transverse members can be determined. Having decided that points of inflection may be assumed at mid-points of members, the moments and axial stresses can be easily computed. In Fig. 3 a stress sheet is shown for a longitudinal frame; Fig. 4 shows details of the rigid-frame design.

In the rigid-frame design concrete was assumed to develop 2,200 lb. per sq.in. at 28 days; but 25 per cent increase was allowed, on the assumption that the extreme stresses would not have developed for a considerable time after completion of the building. The ratio of moduli of elasticity of steel and concrete was assumed to be 12, and the allowable steel stress used was 18,000 lb. per sq.in. High values of allowable shear and diagonal tension are used, as all members in bending are reinforced with stirrups, and reinforcing steel is fully anchored. For the two-way slabs, reduced bending coefficients are used, in accordance with recent building codes.

Cost comparison

The following comparative estimates show that, for this large heavy building the rigid type of foundation is about 14 per cent more expensive than the pile foundation. In the latter it will be noted that hand excavation around pile tops has been figured at $2, while in the rigid foundation it has been figured at $1.50 as being slightly easier. Forms in the floating-pile design have been priced at 12c., because they include the first-floor girderless slab and a considerable amount of simple basement slab forms, which would cost less than the cut-up slab and girder design, with haunched beams and bracketed columns of the rigid-frame design.

Additional expense justified

There can be no doubt that, for the case studied, the additional 14 per cent in cost is justified. It insures against unequal settlement by a definite structural design, based on closely approximated stresses. For more complicated buildings, such as those having heavy towers in the middle or at the ends or those irregular in plan, the problem is more difficult. The expense of providing rigidity is greater, but the probable injury from uneven settlement is also much greater. It would seem to be established without a doubt that every building, no matter how complicated, resting on a thick stratum of compressible soil, should be carefully investigated from the standpoint of making its foundation rigid.

COMPARISON OF COSTS OF A PILE FOUNDATION AND A RIGID-FRAME FOUNDATION

Pile Foundation	
10,210 cu.yd. excav., steam shovel @ 0.40	$4,084
1,375 cu.yd. excav., hand @ 2.00	2,750
2,346 piles, 50 t. @ $.45 @ 22.50	52,785
2,983 cu.yd. concrete, 1:2:4 @ 7.25	21,627
242 cu.yd. concrete, 1:1½:3 @ 7.00	1,936
75,776 sq.ft. forms (make, place, strip) @ 0.12	9,093
401,130 lb. reinf. steel, in place @ 0.0375	15,042
Total	$107,317
Rigid Foundation	
11,231 cu.yd. excav., steam shovel @ 0.40	4,492
1,018 cu.yd. excav., and, @ 1.50	1,527
4,545 cu.yd. concrete, 1:2:4 @ 7.25	32,951
70,806 sq.ft. forms (make, place, strip) @ 0.15	10,621
1,941,070 lb. reinf. steel, in place @ 0.0375	72,790
Total	$122,381

Where it is found that towers or ells cannot be made integral with the rest of the building on account of the expense, they should be constructed separately and allowed to settle independently.

In many cases it might be practicable to make the basement two stories in height, as in the Albany Telephone Building, and the writer believes that, provided two basements are desired, this might make a considerable saving in the cost of the rigid frame. Again, a considerable saving might be made by introducing diagonals in the bays of the Vierendeel trusses where the shear is heaviest, thereby reducing the heaviest members considerably.

In these studies, furthermore, the entire reliance for stiffness has been upon the foundation of the structure. In a building as high as this it might be feasible to furnish a considerable part of the rigidity through additional bracing of the superstructure, which should, in any case, have some stiffness to resist wind pressure. But even for the case that has been studied here, it is believed that the advantage of the rigid design has been clearly proved.

Bell and Spigot Joints Tested at Ohio State University

FAILURE TESTS of cast-iron water pipe, to determine bell rupture and pull-out strength, led to the development of a formula which expresses the pressure at which initial failure may be expected in a joint of bell-and-spigot pipe. The tests are described in *Bulletin 87* of the Engineering Experiment Station of Ohio State University, by Prof. John C. Prior, under whose direction the work was carried out.

A.W.W.A. standard, 20 in., Class D, uncoated pipes were used to make deflection tests, with special reference to bell strength; in different tests the joints were made up with lead, cement and sulphur compounds, respectively. A Riehle 1,000,000-lb. beam-testing machine was adapted to apply pressure to a 12-ft. assembly of two 6-ft. lengths of pipe with the joint in the center, and a Berry strain gage was used to measure the distribution and magnitude of the strains developed in the bell during the test.

All the tests were extended well beyond the failure point of each joint, and the significant fact developed was that broken or cracked bells, due to deflected pipe, would be rare on the 20-in. sizes when using present A.W.W.A. standard pipe.

Strain diagrams indicated that, if sufficiently strong jointing materials were available to rupture the bell, an arc would be broken out approximating its upper quarter.

Using lead joints, it was found that calking was responsible for one-third to one-half of the maximum bell strain that the joint could sustain. Harder jointing materials like sulphur compounds or portland cement were destroyed before conditions causing maximum strain from deflection were reached.

Sulphur compounds and lead were tested for pull-out strength in joints on pipe ranging in size from 6 to 60 in. in diameter. Two lengths of Class D pipe were assembled with the joint in the middle and the open ends closed with 250-lb. flanges. Regulated water pressure was applied to the interior of the unit, and the spigot section was free to move as the joint was pushed apart. The pressure at which incipient failure may be expected for calked lead joints was found to be expressed by $P = \frac{3800}{D+6} - 40$, in which D is the nominal diameter of the pipe in inches and P the pressure of the contained liquid in pounds per square inch. This formula cannot be used for pipe diameters beyond 60 in. A few tests on joints made up with sulphur compounds indicated that the same expression may also be used for these.

Lead showed a distinct flow under the loads, indicating that a joint will sustain for a brief time a much larger load than it will carry for a long period. There appeared to be no relation between the quantity of leakage and the size of the pipe. In nearly every test, failure began by the spigot slipping through or out of the lead.

A single long-time experiment with a sulphur-compound joint indicated that the strength of the material improves greatly with age, and one joint re-waterproofed itself after it had been broken.

The Construction Code and What It Taught

[*In Two Parts*]

PART II—Serious obstacles to effective administration of the construction code arose from inter-code conflicts, from labor and wage questions, and above all from lack of enforcement, but the progress achieved toward integration of the industry and toward improvement of labor relations justifies careful study of what may be achieved through voluntary cooperation

BY JAMES W. FOLLIN

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ONE of the troublesome administrative problems that had not been solved when the code structure collapsed as a result of the Supreme Court's finding of unconstitutionality was that of overlapping jurisdiction between the construction code and other codes. Apart from the question of code assessments, there was the more important question of maintaining fair competition, which purpose required that members of these other industries should not be allowed to perform construction except under wage and hour provisions equal to those of the construction code.

The code defined construction functionally to cover all designing, constructing and installing of construction products, but this broad coverage was vigorously protested by manufacturers, who claimed that their own codes should cover not only manufacturing operations but also (*a*) all construction on their premises and (*b*) installation of their products in construction. A compromise was embodied in an inter-code agreement drafted by the Construction Code Authority and the Cotton Textile Code Authority, which had been sent to NRA but not approved at the time of code suspension. This agreement provided that maintenance work and minor extensions and replacements, when made by the manufacturer's forces regularly engaged in such work, should be governed by the provisions of the cotton textile code and not by the construction code, but that all other construction work performed on the manufacturer's premises should be governed by the construction code.

Similarly, overlapping of the construction code and the aggregates code (code of the crushed stone, sand, gravel and slag industry) was temporarily compromised by exempting the contractor-producer from the provisions of the aggregates code, provided that he conformed to the more stringent conditions imposed by either code.

But there were many other overlaps less easy to dispose of. Thus, several divisions of the construction industry ran into conflict with the retail code, particularly the resilient-flooring contracting division, in whose field 50 per cent of total gross volume was installed by department stores having contract departments. The roofing and sheet metal and the plumbing contracting divisions bumped against the operations of hardware and general stores doing a miscellaneous line of selling or installing construction products. Again, the operations of certain large chain department stores came into question, principally as to whether such units were required to pay the minimum wages for skilled labor fixed in the pertinent chapters of the construction code.

The effort of the land development and home builders group to get a separate code was actuated by this same motive of escaping the wage and hour provisions of the construction code, as well as the desire to avoid the assessments levied by the code.

Labor problems and jurisdictional disputes

Since one major purpose of the code system was to develop and promote sound labor relations, it is important to ask what was accomplished in this direction. The answer is that little was accomplished.

In addition to providing means for dealing with routine labor questions, the code created an industrial-relations body of model kind, the Construction Planning and Adjustment Board, composed of ten men representing employers, ten representing employees and an impartial chairman. The employer members were to be nominated by the Construction Code Authority and selected by the Industrial Advisory Board of NRA with approval of the Administrator, while the employee members were to be nominated by employee organizations and selected by the Labor Advisory Board of NRA with approval of the Administrator.

The labor members, nominated by the American Federation of Labor, were all presidents of building-trade unions; thus the large body of unorganized labor was not represented. The employer members comprised architects, engineers, subcontractors and general contractors. The impartial chairman, appointed by the President, was Sullivan W. Jones, architect, of New York City.

This P & A board had certain minor discretionary duties in the way of approving the working of employees more than 40 hours a week on construction work at remote and inaccessible locations where workers had to be boarded on the job, or where there was a shortage of qualified workers (though the board never admitted this latter condition to exist). Fundamentally, however, the board was charged with responsibility for the planning and development of policies that would promote better relations between employers and employees, and for the furtherance of other mutual employer-employee interests.

Of first importance in this broad program was the problem of trade jurisdictional disputes. President Roosevelt, in a letter accompanying approval of the code on Jan. 31, 1934, instructed the board to make a thorough study of such disputes and methods of their prevention and amicable solution, and to submit its findings and recommendations to him for such action or order as might be appropriate. It is to the credit of the employee members of the board particularly that, in spite of antagonisms that had arisen because of certain jurisdictional decisions in the past, unanimous agreement was reached on a plan under

which the unions in the Building Trades Department of the American Federation of Labor would agree not to strike pending initial determination by a committee of two (the chairman of the P & A Board and the president of the Building Trades Department) and ultimate determination by a Jurisdictional Disputes Board comprising three disinterested members.

This nobly conceived plan was wrecked, however, by a fight between two opposing groups in the Building Trades Department for control of the department. Thus the code did not contribute toward solution of the vexing problem of jurisdictional disputes, a source of great annual loss to the public that pays for construction.

Wage problems and area agreements

Wage questions were a prime instance of unsatisfactory working of the code. Minimum-wage rates for skilled workers were not fixed by the construction code (except in a few subcontractor chapters) but were to be established by mutual area agreements reached through collective bargaining. The area might be the entire United States or it might be a region or locality, and each division or subdivision of the industry could fix its minimum skilled rates by this process without interference by other divisions. Toward the end of the code period an amendment was approved which permitted several divisions to negotiate a joint area agreement, an arrangement found desirable in some states where special contracting was less developed.

Although considerable effort was devoted to arriving at area agreements, the number presented to NRA for approval was limited to a few hundreds out of many thousands that would be required to cover metropolitan centers alone. Only about 50 received final approval. As might be expected, the rates and hours in such agreements varied considerably as between large and small centers and different divisions (*ENR*, Feb. 28, 1935, p. 333, and May 9, p. 688).

Regulations issued by NRA for the effectuation of area agreements were unnecessarily restrictive. The principal difficulty was in securing sufficiently high representation of the negotiating parties, in order that the President, by approving these regulations for application to all employers in such localities, would not be imposing hardship on those who had not agreed, in removing the right of private negotiation and contract. Several schemes were proposed for overcoming this difficulty. The best was a plan for electing by majority vote the members of the negotiating committees, these committees to be empowered to complete the negotiations and bind all those entitled to vote for election of the negotiating committee.

Since the area-agreement provision of the code was the fundamental basis of fixing minimum skilled-labor rates, such chapters as contained skilled-labor rates made these provisions subject to the absence of area agreements. The divisional chapters for plumbing contractors, heating, piping and air-conditioning contractors, and plastering and lathing contractors carried the PWA rates (40, 45 and 50c. unskilled; $1.00, $1.10, $1.20 skilled, in the southern, central and northern zones, respectively). The electrical contracting chapter carried a minimum rate of 75c. per hour throughout the United States.

Experience with the electrical contracting rate was fairly satisfactory; the rate was not high enough to discourage the negotiating of area agreements, nor was it so high as to impose a hardship in outlying regions. The PWA rates in the other three chapters, however, ran into considerable difficulty. Because of this experience, on protest of employing groups, the skilled rates were stayed in some rather extensive territories, even in entire states, and after hearing and investigation lower rates were established in such areas (*ENR*, April 25, 1935, p. 607).

Bidding practices

Designed primarily to establish a system for protecting the honesty of bids on competitive work, the bidding-practice rules of the code were the subject of the greatest discussion. Numerout explanations were issued by the code authority to clarify their application, and at the end major revisions had been prepared by a special committee for action by the code authority.

These regulations were criticised by some as not going far enough, by others as going too far. Yet, though prepared in a comparatively short period by an industry committee, they had stood legal test fairly well. They will guide future industry-regulation efforts. Particularly the system of bid depositories merits permanent application to the industry as a safeguard of honest bidding against sharp practice.

The statistical problem

One of the major services contemplated by the Construction Code Authority under industry integration was the assembling of authoritative and useful statistics, for the first time, of the entire construction industry. Its importance lies in the fact that without it no plans for stabilization are possible.

In cooperation with the Bureau of the Census and the Central Statistical Board of the government, the CCA embarked upon a statistical program in January, 1935, by sending questionnaires to about 130,000 employers asking for the month of January the number of employees and total hours of work, amount of payroll, amount of construction work completed, and new orders taken. Some 20,000 returns were received—a highly encouraging result in view of the necessity of educating the industry to the importance of comprehensive figures. A later questionnaire, for February and March, was sent out to those who had answered the first questionnaire. Continuation of the monthly questionnaires to the entire industry was in course of preparation when the code system came to an end.

The code ineffectively enforced

As in many other industries, continual complaint was heard that the lack of adequate enforcement of the code by NRA was nullifying the best efforts of the industry's administrative committees. Looking back upon the experience with compliance, it is clear that the industry itself as well as NRA was to blame for ineffective enforcement. The industry had not yet learned that enforcement can be based only on adequate information and systematic procedure.

It now seems that NRA's ineffectiveness in enforcement may have resulted somewhat from hesitancy to push enforcement because of doubts as to the legality of its acts. In spite of this, the industry won some notable victories in enforcement cases involving not only wage and hour provisions but the requirements for filing duplicate copies of bids and even for selling products at not less than estimated cost. Had the code continued, the primary requirement would have been to organize industry compliance more effectively through local code councils and to assure more rapid reference of non-adjusted cases to federal district attorneys for action.

C—Code Experience Summarized

BECAUSE of the many kinds of difficulties and obstacles to effective code administration that were encountered, as above reported, a brief restatement of the major difficulties may be helpful. The following six points are expressed in different terms and cited in different order from the preceding fuller statement:

1. While most of the construction code structure was completed at the time the codes were declared invalid, the system had not been in operation sufficiently long to demonstrate whether the industry could be governed through the particular machinery provided. It became more and more evident that the machinery would probably have to be modified in the light of operating conditions before it could succeed.

2. Financial support was generally inadequate to provide effective self-

government. However, the plan for local integration and coordinated administration promised at least a partial solution of this problem.

3. The code did not receive general acceptance from members of the industry; it had not been sold effectively. Here it is proper to bear in mind, however, how great a number of employer units (approximately 150,000) had to be governed. Neither time nor money had been adequate for the educational work necessary to place the value of the code effectively before the greater number of employers.

4. NRA compliance efforts never reached sufficient development for quick and effective operation. Actual enforcement was found to be a long, tedious and uncertain process. Nor had the industry organized to bring forward promptly full information on violations, or developed procedures for adjusting complaint cases or for making quick enforcement action possible.

5. Minimum-wage rates, for skilled labor particularly, were inadequately defined to supply a fair basis of competition. Because of the negligible number of area agreements formulated and approved, fair competitive bidding practices were greatly handicapped.

6. The absence of uniform principle and policies in NRA was a fatal handicap to effective code administration. Its effect was particularly serious in making it impossible to maintain the integrity of the construction code definition against the subversive efforts of manufacturing groups who demanded the right to install their products in construction or to perform construction at their own plants without being bound by the requirements of the construction code.

If this condensed summary of code experience is carefully considered, the fact becomes apparent that completely successful self-regulation of construction through the code could not be achieved because of a number of grave deficiencies and obstacles. But it is also apparent that some of these obstacles were in process of being surmounted and no doubt would have been surmounted had the code continued in operation for another year or more, affording time to work out the practical difficulties revealed by experience.

But while taking note of these unfavorable experiences it is also in order to record two outstanding gains made through the code—though neither of them may survive if the members of the construction groups take no steps toward assuring their maintenance. These gains are the promising advance made toward integration of the industry, and the trail blazed through the tangle of unstable labor relations by the work of the Construction Planning and Adjustment Board.

As to these it is fair to record the following facts:

7. The P & A board, while it failed to attain its initial major objective of eliminating jurisdictional disputes, accomplished the great result of bringing together employers and employees for round-table conference. Unquestionably this was one of the major accomplishments of the code. The continuance of such a conference board over an extended period would result in major advantages to both employers and employees and hence to the buyer of construction.

8. Some measure of integration was accomplished by the code, in the face of the difficulty experienced both before the code and after the code in bringing together the many elements of the industry for effective and unified industry action on common problems. This was an achievement of the first magnitude. It is a tribute to those leaders in the industry who pushed through the program quickly in spite of all obstacles. While all was not clear sailing under the integrated code, and several controversies had arisen which threatened to destroy the integration, it seems most probable that the changes in code structure shown by administrative experience to be necessary would have restored complete confidence in the integrated code.

D—The Outlook for Construction Regulation

HAVING thus reviewed the experience in code operation, we return to the question raised in the beginning: What course is open for eliminating unsound practices from construction? What may be expected from voluntary effort by the industry itself, now that the code structure has collapsed? First, it is well to note certain facts as to governmental regulation and voluntary action.

Construction operations have for some years been partly regulated by federal, state and local governments. Wage rates, and in some cases maximum hours of employment, are fixed under such measures as the Bacon-Davis Bill, the regulations of the PWA—the Federal Emergency Administration of Public Works—and other federal agencies (such as subsistence homesteads), and by various state and local acts. The Walsh Bill, killed by the last session of Congress, would further have regulated wages and hours on government work. Also, several states have provided for the licensing of contractors. What the future may bring in the way of complete industry regulation through a new federal act or through state acts is uncertain at this time, but in any event the trade-practice phase of the problem of bringing about equitable and efficient conditions in the industry would remain untouched.

The possibilities of voluntary industry action are generally unexplored. There are isolated instances of such cooperative action in the past years, but none of large extent or long duration. None, moreover, was as complete in scope as the code.

It seems clear that action by the industry under some form of voluntary code that may be developed with governmental sanction, or cooperation without such sanction, must be predicated largely upon local action and agreement. While the construction code was a national code, in most respects it was based on local determinations. Area agreements on working conditions, though they could have been effectuated for the entire country or for regions or entire states, were generally limited to specified cities or metropolitan areas of such cities.

Similarly administration of the code in the majority of the divisions was properly delegated to state and local agencies. Bid depositories were established principally for local areas. The trend was unmistakably toward integration of the industry through local code councils and consolidated divisional administration.

Accordingly, progress henceforth in industrial regulation will inevitably be dependent in the last analysis on state and local action, as was the case before the code. Logically such action will be guided and supported by national trade associations, including the Construction League, which is attempting to integrate the actions of such national organizations.

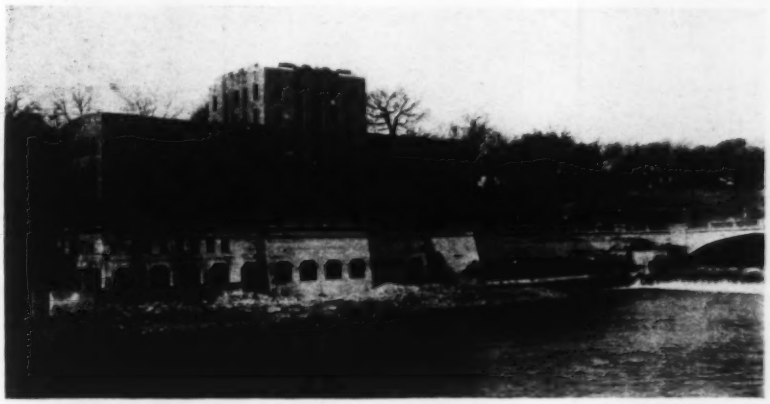
The extent to which these local efforts may accomplish results will depend primarily upon the willingness of the various elements of the industry to work together for the common good, burying various antagonisms, particularly those between buyer and seller groups. Already it is reported that one of the largest cities will attempt through its trade associations to establish and maintain a bid depository substantially for the entire construction industry, and other evidences are at hand of joint industry action.

It is too early as yet to forecast the success which may be attained through such efforts. Perhaps some time will be required for the industry to recover from the effects of the code lapse and to develop a program to retain the benefits which the construction code promised.

Research Notes

Hydraulic Research at Iowa University

By F. T. Mavis
In Charge of Laboratory and Acting Head, Department of Mechanics and Hydraulics, State University of Iowa, Iowa City, Iowa



HYDRAULIC TESTING FACILITIES at Iowa University are concentrated in this fine building just downstream of the dam across the Iowa River.

THE hydraulics laboratory of the University of Iowa serves a dual function in engineering education and in cooperative engineering research. On the one hand, students are instructed in hydraulic laboratory practice, and on the other a staff of engineers and technicians representing various divisions of professional and business activity are engaged in investigating and planning hydraulic engineering projects on a scale that would not be considered academic. The work in hydraulics is administered through the department of mechanics and hydraulics. Investigations which are directly applicable to specific engineering projects are conducted through the Iowa Institute of Hydraulic Research, which was organized as a separate department by the Iowa State Board of Education in 1931. It is an integral part of the college of engineering, of which C. C. Williams is dean. The Institute of Hydraulic Research was organized to afford an agency for the coordination of the talent, facilities and the resources that may be made available at the University of Iowa for undertaking projects of unusual magnitude, scope or complexity in the field of hydrology and hydraulic engineering.

Investigations are conducted under the direction of the operating staff and cooperating engineers. The consultants from the cognate departments of the university faculty are available for counsel, either as a group or singly, concerning aspects of hydraulic problems which involve their respective fields. The institute affords a connection through which technical societies, governmental departments, municipalities, industries, corporations and other interested parties may effectively cooperate with the university in the field of hydraulic research.

For some time the major cooperative work has been carried on with three federal departments: the Bureau of Agricultural Engineering, U. S. Department of Agriculture, represented by D. L. Yarnell; the U. S. Engineer Office of the War Department, represented by Martin E. Nelson; and the U. S. Geological Survey, Water Resources Branch, represented by R. G. Kasel. Each of these departments normally maintains a staff of engineers and technicians who are engaged to carry on the several research projects in cooperation with the institute. More recently other studies have been carried on jointly with the Iowa State Planning Board, represented by R. H. Matson, coordinator, Prof. A. C. Trowbridge, chairman of the water resources division, and Prof. P. H. Elwood, director-consultant of the board.

Laboratory facilities

The main building of the hydraulics laboratory is located on the right bank of the Iowa River just below the University Dam. Water impounded by the dam, with a normal head of about 10 ft., can be diverted through headworks and regulated for use in testing large-scale models or full-sized structures in one or both of the river channels. One channel is 10 ft. wide and 300 ft. long, and extends underneath the main building for about half its length. The other channel, 16 ft. wide and 100 ft. long, lies wholly under the structure. The channels can be closed and heated. The river water can be measured by means of weirs in the channels or by means of a side-contraction meter in a 48-in. steel pipe extending from the dam to the laboratory building.

With this issue, the series of articles on current research in the college laboratories is resumed. The articles already published cover investigations at

Lehigh	**Feb. 15, 1934, p. 225**
Ohio State	**May 24, 1934, p. 666**
Wisconsin	**March 28, 1935, p. 455**
Lehigh	**April 25, 1935, p. 588**
Illinois	**June 6, 1935, p. 798**

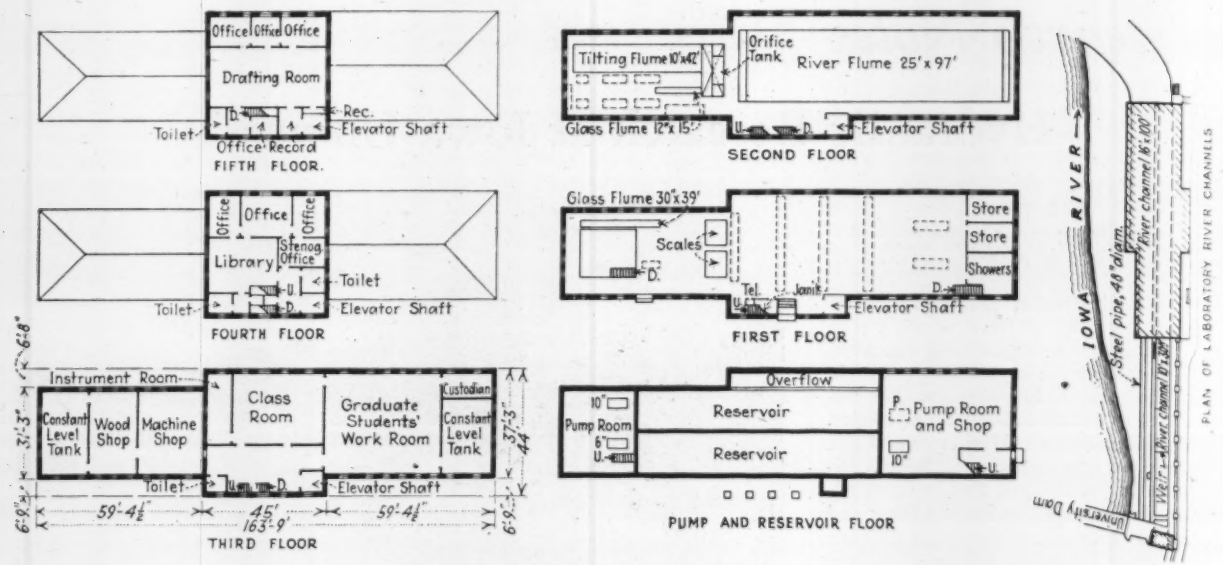
Following this article on hydraulic research at Iowa University, current work at Purdue and Iowa State College will be covered.

The main building, which is devoted to offices, shops and class-rooms in addition to applied hydraulic laboratory work, is a five-story brick structure 164 ft. long and 44 ft. wide. General floor plans are shown in the accompanying drawing. Revisions are being made to improve the facilities for graduate students' work on the third floor of the laboratory. The first and second floors are given over entirely to hydraulic model work as are also the river channels mentioned. Water is circulated from the reservoirs in the basement to the constant-level tanks on the third floor, from which it is supplied to models and to certain fixed equipment on the first and second floors of the building.

Excepting flumes, there is relatively little fixed equipment in the laboratory. On the second floor there is a tilting steel flume 10 ft. wide and 42 ft. long, which has been used to accommodate a variety of laboratory investigations. A glass walled flume, 12 in. wide and 15 ft. long, and a river-model flume, 25 ft. wide and 97 ft. long, represent the two extremes on the second floor. In addition, there is a weir and orifice tank that is used almost exclusively in undergraduate instruction.

The fixed equipment on the first floor includes a glass flume, 30 in. wide and 39 ft. long, and two steel tanks mounted on scales with a capacity of 18,000 lb. each.

The space in the main hydraulics laboratory building has been outgrown, and a pump and reservoirs have been installed in the old manufactures laboratory recently vacated by the mechanical engineering department. The effective floor space, 53 by 105 ft., in this annex has been used chiefly for river models.



FLOOR PLANS and river channels in the Iowa Institute of Hydraulic Research.

Many of the reports of student investigations that have been completed are in the form of official memoranda or theses not released for publication. These investigations cover such subjects as flow in open and closed conduits, hydraulic jump, measuring devices, channel obstructions, transportation of detritus, percolation and filtration, draft tubes and dams. Most of the important staff and cooperative studies, however, are available in published form as listed in the accompanying tabulation.

Current researches

Currently a number of important investigations are under way or approaching completion at the institute. The following abstracts cover some of these studies carried on by major staff members and graduate students during the academic year 1934-1935.

Transportation of Detritus—"University of Iowa Studies in Engineering, Bulletin 5," by F. T. Mavis, Chitty Ho, and Yun Cheng Tu, presents a critical digest of representative investigations into the problems of transportation of detritus. Tests were conducted in the laboratory, to determine the competent velocities at which grains of sand, fine gravel, Haydite, and crushed limestone commenced to move along the bed of a rectangular open channel 30 in. wide. Under conditions of competence, velocities were measured as close as ⅛ in. to the sand bed, and competent bottom velocities were estimated on the basis of velocity-depth curves. The mean apparent specific gravities of materials tested were 1.83, 2.60 and 2.64. The following formula was found to be in substantial agreement with the tests on uni-granular materials conducted in the laboratory by Chitty Ho and Yun Cheng Tu:

$$V_0 = \tfrac{1}{2}\, d^{1/2}(s - 1)^{1/2}$$

in which V_0 is the competent bottom velocity, in ft. per sec., at which grains of material begin to move across their bed, d is the mean diameter of grain, in mm., and s is the apparent specific gravity of the grains.

Bottom-Load Transport in Open Channels—A master's thesis by Te Yun Liu, prepared jointly with A. M. Carter, presents the results of an effort to determine for a limited range of materials the traction load—namely, the weight of material transported in a given time, as a function of the bottom velocity, size, shape and specific gravity of the materials. The tests were conducted in a glass-walled flume 15 ft. long, 1 ft. wide and 2 ft. deep. The sand bed, 1 ft. long and 1 ft. wide, was maintained at the level of a false floor during each of the tests conducted. Four uni-granular materials were tested, crushed limestone 5.5 mm. in diameter and crushed limestone 2.8 mm. in diameter each having a specific gravity of 2.69; coarse river sand 2.9 mm. in diameter with a specific gravity of 2.64; and finer sand 1.4 mm. in diameter with a specific gravity of 2.58. An analysis of the data obtained for loads varying from 0 to about 50 lb. per ft.-hr. for these particular materials and tests indicated that the traction load varied approximately with the 15th power of the bottom velocity. No general conclusions have been drawn on the basis of the tests so far completed.

Bodies Falling in a Turbulent Stream—The object of this study by G. F. Djang was to investigate analytically and experimentally the drift distance of a body (small balls and paper disks) falling freely in a stream in which there were different degrees of turbulence. For mathematical simplicity, the theoretical investigation was limited to two cases in which the resistance is proportional respectively to the first and second power of the velocity.

The following conclusions were drawn: (1) for a given velocity distribution, the mathematical expressions for the drift distance are of the same form whether the resistance varies with the first or second power of the velocity; (2) a working formula is proposed

$$x = U\left(t - \frac{2^n}{np}\right)$$

in which x is the drift distance, t is the time of fall, U is the mean velocity of the stream, and n and p are constants involving the mass and density of the body and the nature of the fluid; and (3) the effect of turbulence on drift distance and time of fall can be treated advantageously by means of the Brownian movement method.

Stilling Pools for Spillways — A thesis by C. W. Kinney reports experiments conducted to investigate the use of the hydraulic jump as a means of preventing erosion below model spillways. In the experiments the hydraulic jump was formed on a smooth apron below an undershot gate. A sill of rectangular cross-section was fastened to the lower end of the apron. The opening beneath the undershot gate, the quantity of discharge, the length of apron and the height of sill were varied, and observations were made of the erosion of the sand below the apron. The studies are to be carried further on both a larger and a smaller scale of apparatus.

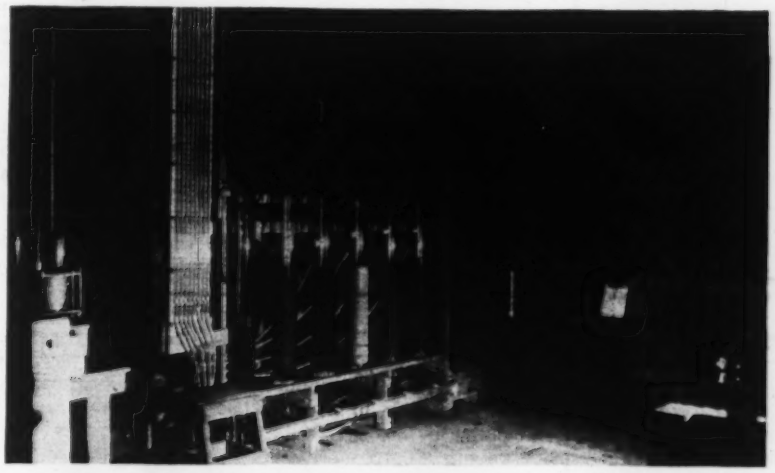
Spreading Draft Tubes—A dissertation by Andreas Luksch presents a critical digest of theories and tests of spreading draft tubes by Prasil, White, Moody, Kaplan and Spannhake, and describes tests conducted on a small metal draft tube and on its counterpart in clear glass. The objects of the experiments were: (1) to determine for a

model draft tube the discharge under constant head as a function of the distance of the draft-tube outlet from the tailrace floor; (2) to determine the effect of vertical components of flow on the relation between the discharge under constant head and the distance of the draft tube from the tailrace floor; (3) to observe and to study the stream paths in a glass-model draft tube; and (4) to apply an electrical analogy and a graphical method to the analysis of the flow through a spreading tube.

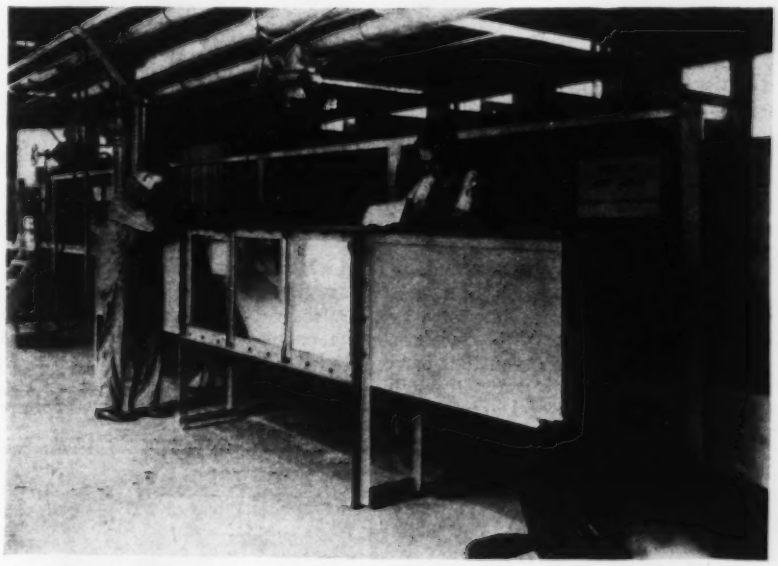
The following conclusions were drawn from the tests: (1) For axial flow the discharge under constant head is a maximum if the distance of the draft-tube outlet from the tailrace floor is about $\frac{1}{4}\ d$, where d is the throat diameter of the draft tube; for greater distances the discharge decreases rapidly; for free discharge it is only about 70 per cent of the maximum. (2) For rotational flow the discharge is independent of the distance of the draft-tube outlet above the floor if the distance is greater than about $\frac{1}{4}\ d$. (3) Axial-flow conditions can exist in actual water-turbine operation, and therefore a bell-shaped draft tube should be located at the position of maximum discharge for axial flow. (4) Observations of the glass model indicated that for axial entrance conditions the flow does not fill the divergent part of the tube unless the distance of the outlet is about $\frac{1}{4}\ d$ above the tailrace floor; in that position the floor has the effect of forcing the flow to follow the walls of the draft tube. (5) For rotational flow a vortex forms close to the axis, and most of the discharge through the tube takes place near the side walls. For distances greater than about $\frac{1}{4}\ d$, the location of the tailrace floor does not affect the vortex motion, and it has no effect on the flow through the draft tube under conditions of non-axial entrance.

Two-Dimensional Flow by Electrical Analogy — This study by Lt. H. F. Sykes, Jr., is the third of a series of investigations into the use of an electrical analogy in the solution of certain problems in hydrodynamics. The thesis presents the mathematical interpretation of the analogy and explains briefly by illustrative examples approaches to the solution of hydrodynamics problems: (1) by the assumption of a functional relationship, (2) by the method of Schwarz-Christoffel, (3) by the velocity method (conformal mapping), (4) by graphical solution, and (5) by the electrical analogy.

The electrical analogy is applied to the solution of: (1) the flow over an infinitely long cylinder resting on a horizontal plane; (2) the flow in a channel of uniform depth whose width changes abruptly from w to $\frac{1}{2}\ w$; (3) the electrostatic flux lines and equipotential lines for an electrostatic machine for producing pure tones; (4) the surfaces normal to the flow lines through a spreading draft tube assuming a per-



APPARATUS for studying the hydraulics of sand filters consists of a battery of glass tubes containing various sands.



FLOW OVER a model spillway being studied in a glass flume 1 ft. wide, 2 ft. deep and 15 ft. long.

ERODIBLE-BED MODEL of the Mississippi River below the navigation lock and dam at Alton, Ill.

fect liquid; and (5) the pressure distribution on the upstream face of a spillway dam.

Overflow Sections With Sand Core—A thesis by Lt. H. J. Skidmore reported the results of tests to investigate the feasibility of constructing overflow sections of sand paved with an articulated mattress of concrete. The models were constructed to one-fifth scale, representing a sand-fill embankment 40 ft. wide with an upstream slope 1 on 3, and a downstream slope 1 on 5½. Four models were tested: No. 1 having a crest sloping 1 in. in 10 ft. in the direction of flow; No. 2 having a slope of 3 in. in 10 ft. in the direction of flow; No. 3 and 4 having an ogee curb 0.4 ft. high and 0.97 ft. wide at the base in the model. The coefficients of discharge for the overflow sections under both free and submerged conditions were determined. Tests were also conducted to determine the velocity of seepage flow through the sand core.

It was concluded that if the relative elevations of head- and tailwater can be controlled, the overflow sections with sand core and curb would provide a satisfactory spillway section where additional spillway capacity is needed for floodflows. An articulated paving is considered necessary to take care of settlement of the fill. Further studies on a larger scale are recommended.

Permeability of Sand—An effort was made by E. F. Wilsey to determine by experiment the effect of temperature, porosity, shape and size of the sand grains on the flow of water through sand within the limits of Darcy's Law.

Two empirical formulas were devised as follows:

For Iowa River sand (an angular sand)

$$k = 0.814 \frac{\mu_{60}}{\mu_t}\left(\frac{p}{40}\right)^6 d^2$$

For Ottawa sand (a rounded sand)

$$k = 1.24 \frac{\mu_{60}}{\mu_t}\left(\frac{p}{40}\right)^5 d^2$$

where k is the permeability in cm. per sec., μ_{60} and μ_t are the absolute viscosities at 60 and t deg. F., respectively; p is the per cent porosity; and d is that diameter such that 10 per cent of the material is of smaller grains.

The following conclusions were drawn: (1) The rate of flow of water through sand is inversely proportional to the absolute viscosity of the water. (2) For a given porosity of 40 per cent, the permeability of the Ottawa sand was 50 per cent greater than that of the Iowa River sand, the diameters of the grains ranging from 0.68 to 0.93 mm. in both samples. (3) The permeability of uni-granular sands is proportional to the square of the average diameter of the sand grains. (4) The "effective size" as defined by Slichter was found to be approximately that size such that 31 per cent of the material is of smaller grains. (5) Other factors remaining unchanged, the permeability of graded sands is proportional to the square of the 10 per cent effective size as defined by Hazen. (6) The upper limit of Darcy's Law was reached when the apparent velocity through Iowa River sand was approximately 0.029 cm. per sec., the porosity being about 40 per cent. (7) In order to correlate the data of various experimenters, a standard apparatus and a standard sand must be adopted.

Parallel studies were carried on by C. C. Wang, using a small permeameter designed by Prof. A. F. Meyer for determining the permeability of sandstones. These investigations are to be carried further, using a wider variety of shapes and gradations of sands.

Groundwater Profiles — Tests conducted by Tsung-pei Tsui had as their objective the investigation of groundwater profiles in a sand-filled trough 18 ft. long, 34 in. deep and 12 ft. wide. Depths of water at the inlet and outlet ends of the trough were varied along with the quantity of flow and the over-all permeability coefficient k in the formula

$$Q = \frac{k}{2l}(h^2_1 - h^2_2)$$

in which Q is the discharge in cu.ft. per day, l is the length of trough, h_1 and h_2 are the depths of water at the inlet and the outlet ends of the trough respectively. The coefficient k for the sand used was found to be 220 ± 20 ft. per day.

The formula

$$Q = 304\left(\frac{h_1 + h_2}{2}\right)\left(\frac{h_1 - h_2}{l}\right)^{1.11}$$

was found to be in much better agreement with the tests, the value of the coefficient being 304 ± 8.

The effective size of the sand used in the tests was .35 mm., and its uniformity coefficient was 2.7.

Project investigations

Numerous laboratory investigations of specific projects have been conducted at the Institute by the U. S. Engineer Department through the District Engineer at St. Paul, Minn., under the supervision of M. E. Nelson. The results of most of these investigations have not yet been released for publication. The more important investigations are briefly described in the following:

Mississippi River Below Keokuk Dam—Tests were made in a fixed-bed model of the river built to a scale 1:125, to determine: (1) a remedy for diagonal currents below the lock; (2) the effect of wing dams and old cofferdam on tailwater of the Keokuk plant; and (3) possible power benefits of excavation in the power-plant tailrace.

Mississippi Lock and Dam No. 4.—Tests were made in a distorted, fixed-bed model of this structure in the St. Paul district, constructed to a horizontal scale 1:300, vertical scale 1:100, to determine hydraulic conditions at the lock approaches and to study the effect of flood spillways in the earth-dam section.

Navigation Lock Model—A typical barge lock was constructed to a scale 1:15, and has subsequently been altered to meet requirements developed by the tests. The model includes the complete hydraulic system for the lock. The object of the tests was to eliminate as many as possible of the features now found to be unsatisfactory in river navigation locks and to increase the efficiency of the hydraulic system of such locks. Improvements in the design of ports that connect the side-wall culverts with the lock chamber have increased the rate of filling and emptying without increasing turbulence in the chamber. Some studies have been made of the entrapment of air at culvert valve wells. The tests to date demonstrate an improvement in conditions at tainter valves in the side-wall culverts when the valve is faced down instead of upstream.

Mississippi Dam No. 26—Two general models with movable beds were built and tested, one with a horizontal scale 1:2[illegible] and a vertical scale 1:60, and the other with a horizontal scale 1:400 and a vertical scale 1:60. The object of the tests was to design control works necessary to maintain a satisfactory navigation channel from the dam in the St. Louis district to the mouth of the Missouri River, and to study the effect of spillway discharge on the riverbed at piers of the railway and highway bridges about 800 ft. below the dam.

Tests were also made of a model which represented 400 ft. of dam and bridges on a scale of 1:25. The model, which was equipped with a movable bed, was constructed and tested in the laboratory's 16-ft. river channel. The object of these tests was to study the effect of spillway discharge on the riverbed below the dam and to design protection for the railway and highway bridge piers.

Mississippi Lock and Dam No. 5—Water-surface profiles in a fixed-bed model, built to a horizontal scale 1:500 and a vertical scale 1:100, were made to conform to open river profiles by roughening the main channel in the model of this lock and dam in the St. Paul district. Timber in the prototype was simulated by scattered pieces of crushed rock. Objects of the tests were to determine: (1) possible erosion of sand dam adjacent to spillways; (2) currents at the locks; (3) backwater caused by the dam; (4) the effectiveness of auxiliary spillways over the sand dam in reducing flood backwater; (5) certain specific effects of a freshet that damaged the construction railway in April, 1934; and (6) possible damages to a railway fill along the right bank.

Mississippi Lock and Dam No. 4—Tests were made in a glass flume on a 1:15 model tainter gate and a 1:30 model roller gate, to determine whether stilling basins designed for roller-gate and tainter-gate spillways would provide adequate protection against erosion at the toe of the dam.

Discharge Coefficients of Short Tubes—One object of this investigation is to determine coefficients that may be used in the design of lock filling and emptying systems. The apparatus consists of a rectangular galvanized iron pipe 6x8 in. in cross-section, 30 ft. long, with a 4-ft. midsection of pyrolin. Standard orifices or short tubes can be inserted in the side of the pyrolin section of pipe. Velocities past the orifice can be varied from 0 to 9 ft. per sec. Orifices can be submerged from 0 to 3.5 ft. The set-up is equipped to measure the hydraulic gradient and velocity in the pipe, submergence of orifice and discharge through the orifice. The investigations have been extended to include tests of eight variations of lock ports. One port model tested had a cross-sectional area at the throat 31 per cent of the area of a 2-in. orifice, but it discharged 20 per cent more water than the orifice.

Roller Gates—Observations were made of the distribution of water pressure on a 1:22.5 model of a roller gate and, with the aid of the Rock Island district office, also on the prototype gate No. 9, dam No. 15, at Rock Island, Ill. Observations in the field were made under three conditions of gate opening.

Tests on Sand Dams—The purpose of the study was to design crests that will permit discharge of floodwaters over sand dams and to investigate the seepage through the dams under various amounts of submergence. The first series of tests was conducted on a 1:5 model built in a glass flume.

Tennessee River, Pickwick Dam—A fixed-bed model of a reach of the Tennessee River was constructed to a horizontal scale 1:450 and a vertical scale 1:150, to determine the best layout for the main units of the project and to establish the locations of operating gates in the dam. The structures include a long earth dam, a lock, a spillway section of dam and a powerhouse.

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Hydraulic System for Pickwick Lock—A 1:30 model of the Pickwick lock was made to study thoroughly all features of the hydraulic system. The side-culvert intakes and outlets, culvert control valves, emptying and filling ports, and the culverts themselves were set up as part of the lock model.

Mississippi Dam No. 20 — One investigation for which conclusions may be given involved tests made on a model of a single tainter gate constructed to a scale 1:20 and on a model of a single roller gate constructed to a scale 1:30. The models of this structure in the Rock Island district were placed in a glass-sided flume where the action of flow through stilling basins and erosion of a sand bed could be observed and photographed. The object of the tests was to determine: (1) general criteria for design of stilling basins for this and other low-head dams on erodible foundations, (2) discharge coefficients for tainter and roller gates, and (3) a schedule of operation at the dam. Two empirical equations were obtained to represent the test data:

(1) For smooth aprons with no end sill:

$$D_2/H_0 = 1.1(L_A/V_2^2)^{0.5}$$

(2) For aprons equipped with two rows of baffle piers and an end sill:

$$D_2/H_0 = 1.1(L_A/V_2^2)^{0.7}$$

in which

D_2 = depth of water on the floor of the stilling basin, ft.
H_0 = head upstream from dam above apron floor, ft.
L_A = length of apron measured from the crest of the gate sill to the downstream edge of the apron, ft.
V_2 = mean velocity on the apron after hydraulic jump occurs, ft. per sec.

Canadian Firm Spends $1,000,000 on New Sugar Refinery

More than $1,000,000 is now being spent at Picture Butte, near Lethbridge, Alberta, by the Canadian Sugar Factories, Ltd., for the erection of a new refinery. The new plant, which is 40 miles from the plant established by the company about two years ago at Raymond, will be for the refining of beet sugar. Contract for the new plant is held by the Dominion Construction Co., Vancouver. The new plant will go into operation in the fall of 1936 and will have a capacity of about 1,300 tons of beets daily. Six modern brick houses are partly completed, and work is under way on six others, which will be for the officers of the factory. The houses vary from four to seven rooms. Concrete footings for the factory are completed, and walls for six bulk storage bins, capable of storing 24,000,000 lb. of sugar, are well under way.

New England Waterworks Men Urge New WPA Rules

Resolution at Providence meeting of N.E.W.W.A. asks changes of WPA waterworks projects to permit competent design and construction—Advances in purification methods and symposium on groundwater practices feature the four-day technical program

Engineering News-Record Staff Report

THE HAZARDS to health and safety which may result from poorly executed waterworks projects under the revised regulations of the WPA, were considered by the New England Water Works Association at its 54th annual convention on Sept. 17-20, with the result that a resolution was adopted requesting President Roosevelt to permit more flexible administration of non-federal waterworks projects. More than 650 members and guests attended the meeting at Providence, R. I., which opened with the presentation of honorary memberships to Frank E. Winsor, chief engineer of the Boston Metropolitan District Water Supply Commission, and to Stephen H. Taylor, superintendent of the New Bedford waterworks. The Dexter Brackett memorial medal, awarded each year for the most meritorious paper printed in the association journal, was given to Karl R. Kennison for his paper on "Boston Metropolitan Water Supply Extensions."

The resolution directed toward modification of WPA rules, originating with and sponsored by the executive committee of the association, was introduced by Willard Chevalier, of *Engineering News-Record*, who stated that some engineers and municipal officials had been too ready to overlook the hazard occasioned by the construction of sanitary facilities with untrained personnel. The present status of work relief projects indicated that WPA had little regard for efficiency but was interested only in making jobs, regardless of the value of a project to the community. A premium thus was being placed on cheapness, the speaker asserted, and quality materials and equipment were disregarded to the point that small consideration was exhibited toward the safeguarding of life and property. Scoring the WPA policy of giving work only to men who are on relief rolls regardless of their qualifications and totally ignoring the competent and skilled worker, who is of vital necessity for successful prosecution of some types of work, it was stated that it has become imperative to make representations directly to Washington if this situation is to be clarified. Improvements of waterworks facilities are economically sound and have a substantial community value which justifies expenditure of federal funds, but this work must be properly designed and executed if this purpose is to be realized. The resolution adopted, read in part as follows:

> "Be it resolved by the New England Water Works Association . . . that the President of the United States be requested and urged to establish suitable regulations to govern the administration of federal-aid to non-federal waterworks projects so as to insure: (a) the prosecution of many such projects now available or readily made available in hundreds of communities, (b) the employment of competent engineers, supervisors and workmen on such projects regardless of whether they are on relief rolls in a proper proportion to insure first grade workmanship, (c) the purchase and installation of material and equipment on a basis of quality and performance that will insure trustworthy operation of such facilities and full protection for each community against failure of structures or equipment that might endanger the health or safety of its people."

Providence watershed reforestation

The technical session of the convention was opened with a paper by Philip J. Holton, superintendent of the Scituate reservoir division on recent developments in connection with the Providence waterworks system. Among other improvements made since August, 1933, are 22 miles of pipe, ranging in size from 6 to 36 in., which were laid to increase distribution facilities and to furnish high service area reinforcement for greater protection in the high valued fire districts. In addition, 238 dead ends were eliminated, and the improved water circulation greatly reduced red water complaints. A new booster pumping station with a total capacity of 11½ m.g.d. was constructed to provide additional supplies for the high service district of Providence and to furnish reserve capacity for fire service.

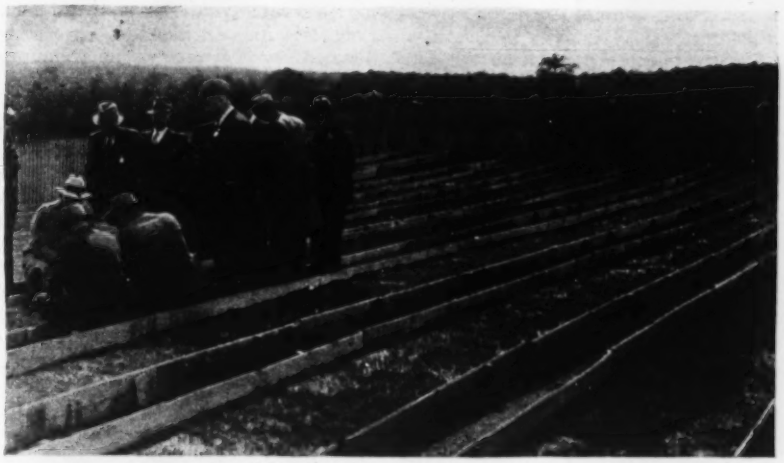
A reforestation program designed for the protection and conservation of the yield from present sources of supply at the Scituate reservoir, inaugurated at the end of 1933, has been undergoing progressive development. The watershed, owned by the city, totals 23.1 sq.mi., an area 5 sq.mi. greater than the city of Providence itself. Water covers approximately 7 sq.mi. of this territory, leaving 16½ sq.mi. to be encompassed in a reforestation program planned on a 10-year schedule. The work includes planting of selected evergreen stock, protection of present desirable growth through systematic thinning and clearing of timber and brush, construction of a network of access roads for fire protection and the clearing of 61 miles of marginal reservoir area. The planting schedule calls for the setting out of 16,000,000 trees over the entire watershed, and to date 850 acres have been covered with 2,000,000 young trees. Coincident with cleaning, thinning and planting operations, 14 miles of belt and access roads have been completed as part of a network which will divide the watershed into 50-acre squares. These roadways, 40 ft. in width, are cleared and grubbed and then covered with sand so that they will serve as fire stops. A 12-ft. wide gravel strip in the center provides a semi-paved foundation for firefighting equipment. To assist in reducing fire hazards a 100-ft. steel frame observation tower has been erected on a site overlooking the entire watershed. Last year, before the tower was erected, 440 acres of valuable timber were destroyed by fire whereas this year less than one acre was lost in a total of 98 fires.

During the initial stages of the reforestation work most of the trees were purchased from Canadian and northern New England nurseries. The difficulties involved in the handling and safeguarding of this stock caused great losses, and plans were projected for the establishment of a nursery on the watershed. The nursery site occupies 20 acres of which 2½ acres are for seeding beds in which 1,500,000 white spruce and red pine seeds were planted this spring. These trees are now about 1 in. high and will be moved next year. Transplanting beds have been prepared on the remainder of the site which has a capacity of 2,500,000 young trees. In addition to substantial savings to be made in the cost of young trees, it is expected that the nursery will provide trees accustomed to the local environment and thus reduce the losses occasioned by transplanting.

Flood emergency work

Emergency protection of water supplies during the July floods in New York State were described by A. F. Dappert, engineer in the division of sanitation of the New York department of health. Treatment plants were washed out in 19 communities and in 23 places the well supply systems were flooded and polluted. Threatened perils, however, did not materialize due to the numerous protective measures carried out, and health conditions in July and August proved to be even better than the records have shown for past years.

Several months previous to the floods, district sanitary offices had been established throughout the state and through these means it became possible for department engineers to compile complete surveys of the stricken area within 48 hours and organize a comprehensive plan of protection. Within three days 93 public water supplies were checked and 42 municipalities were aided in re-establishing potable water service. In addition to the general aid rendered to municipalities, about 10,000 private wells were tested and treated with hypochlorite of lime.



CONVENTION VISITORS inspecting the Providence water department nursery where pine and spruce trees destined for the watershed areas get their start in life.

Water supply in the tropics

Water supply problems in the tropics of Spanish America was the subject of a paper prepared by George C. Bunker, consulting engineer, Ancon, Canal Zone, and read by T. R. Kendall, who at one time was associated with the author. Extremes of rainfall are shown in the records of northern Chile which has 0.8 in. annually and the annual precipitation figures of 331 in. along the Pacific Coast of Colombia. Advantages in water supply practice accruing from the absence of snow and ice are offset by the complications resulting from the rainy season, earthquakes, inadequate transportation facilities and the lack of trained labor. One of the greatest handicaps in making investigations of sources of water supply for Spanish American cities is the lack of rainfall and streamflow data and the rarity of maps.

Surface supplies from nearby streams are the usual source for water facilities. Natural lakes are rarely encountered within short distances of municipalities and impounding reservoirs do not exist. Colombia, however, now has under construction a large dam which will provide storage for 1,100 m.g. of water for Bogota. A few of the largest cities have developed groundwater supplies, among them Lima, Peru (population 207,000), using infiltration galleries, and Iquique, a Chilean seaport, which draws on wells and springs 75 miles inland.

Per capita consumption figures are difficult to enumerate because of the lack of accurate population statistics, absence of meters and undependability of supplies. One coast town of 50,000 population, supplied with springs which are variable in yield, uses from 7 to 17 gal. per capita daily. In Panama City and Colon a charge of 35 and 45 cents, respectively, per 1,000 gal. holds down the consumption of water to 52 gal. per capita. Other communities in Panama with low flat rate charges use as much as 300 gal. per person daily. The writer concluded from his observations and experience that in cities within the tropics having populations over 10,000 the per capita consumption seldom exceeds 105 gal. per day and averages about 60 gallons.

Filtration and chlorination were recommended for every surface supply in the tropics, to free the water from pathogenic bacteria, protozoa, and parasitic worms, but it is exceedingly difficult and rare for municipalities to raise sufficient money for filter plant installation. Slow sand filtration is preferred because operation is not complicated and maintenance expenses are low due to elimination of costly chemical coagulants.

The first steps to improve water supplies in Central and South America were taken in 1904 when Panama City and Colon installed purification plants. It was not until 1915, however, that modern filtration plants were placed in operation in the Panama Canal Zone. Colombia is the only Spanish American country that has made any real progress in water purification, yet of its total 8,000,000 population only 3 per cent receive filtered water and slightly less than 5 per cent have chlorinated supplies. None of the public water supplies of Venezuela were reported to be filtered or chlorinated and in Peru only 7½ per cent of the population receives sterilized water. Ecuador has only one slow filtration plant in operation and this supplies 4½ per cent of the total population. An additional 6 per cent have chlorine-treated water. Bolivia, Honduras and Guatemala have made little progress in water supply, with approximately 5 per cent of the population of each country having chlorinated water available.

Pipe friction data

An abstract of the report made by the committee on pipe line friction coefficients was read by Elson T. Killam, consulting engineer, New York. It summarized the data collected during a two-year research period. The general conclusions were:

(1) The average *actual* loss of capacity of tar-coated cast-iron pipe after 30 years of service, based on a total of 473 tests in 19 different systems, was 52 per cent. The loss *predicted* in the Williams-Hazen table for mains of similar age and diameter (average 20.5 in.) and for "average soft unfiltered river water" is 32.3 per cent.

(2) Based upon the data available to the committee, the Williams-Hazen age coefficient relation is applicable primarily to large diameter mains carrying relatively inactive water.

(3) For small diameter mains carrying active water the actual loss after 30 years may be twice the Williams-Hazen predicted loss.

(4) Other factors being equal, the data show marked correlation between pH value of water carried and rate of capacity loss, average conditions reported indicating for supplies with a pH value of 6.5, twice the loss observed in supplies with a pH value of 8.0.

The report also contained sections dealing with various remedial measures for reducing and preventing loss of capacity. It was recommended by the committee that (1) the study be continued and extended in scope through cooperation with the American Water Works Association, and (2) that typical pipe lines be selected, representative of various conditions, types and sizes of pipe, for periodical tests.

Advances in water purification

Elwood L. Bean, chemist of the Providence water department, described experiences in the treatment of the Scituate reservoir supply in the period 1931 to 1935, during which time various operating changes were made. Raw water is drawn from the reservoir less than 20 ft. from the bottom at a point about 60 ft. below the surface, to take advantage of the natural coagulants in solution in this lower strata, to avoid growths of micro-organisms in the upper layers and to obtain a supply of lowest possible temperature. Analyses have shown that the micro-organism count on the surface water has frequently been as great as ten times the number on

the reservoir bottom, averaging twice as many.

The treatment process from August, 1931 to May, 1932, consisted of copperas (ferrous sulphate) dosing, aeration, addition of lime, mixing, coagulation followed by sedimentation, filtration and secondary aeration. The first modification was chlorination of the copperas solution, to produce ferric iron in the form of chlorinated copperas for the coagulant. After one year of use this was replaced with anhydrous ferric sulphate, a product previously unavailable commercially. This latter compound is very easy to control in application and it offers the same advantages as the other coagulants in reducing the iron content of the effluent, removing manganese and reducing hardness. The pH of the coagulant dosed water is raised by hydrated lime to insure a pH of 9.6 in the plant effluent—this is the point at which all half-bound carbon dioxide is released, thus producing as nearly non-corrosive water as possible.

Tastes and odors are controlled by aeration and with activated carbon treatment. Examination of the carbon mixture supplied through a commercial type unit in which the carbon is dropped directly from the feed fingers into a water eductor showed that the grains were not thoroughly enough dispersed to expose a maximum of absorption surface. A new installation was devised, consisting of a 30-gal. barrel with a float control, inserted between the feed apparatus and the eductor, with a high-speed pump continually recirculating the mixture for intimate dispersion of the carbon before application is made. Approximately twice as much absorption surface was exposed after this change.

Prior to 1931 water was filtered at a pH of 5.8 to 6.2 and the filter sand grains were coated with material adsorbed from this acid solution. Changes in the operating procedure which resulted in filtration at a pH of 9.6 to 10.0 caused dissolution of the previous acid coating by the alkaline water and made cleaning of the sand necessary.

Sludge in the Providence coagulating basins manifests unusual stability and there has been no marked decomposition to affect the water quality even though the basins were without a cleaning for five years. The larger of the two basins with an area of 1.12 million sq.ft. has never been cleaned and now has an average sludge depth of 1-ft.; the smaller basin (440,000 sq.ft.) was cleaned by flushing in 1930 and in 1935, when the sludge had accumulated to a depth of 7 ft. in places.

The bacterial quality of the Scituate reservoir water is of such excellence that chlorination is used only occasionally.

Reviewing progress in supplying less corrosive soft water during recent years, Malcolm Pirnie, consulting engineer, New York, pointed out that changes in purification processes, dictated by laboratory investigations, were largely responsible for the improved quality of water now obtainable. Early experiences with rapid sand filtration showed that the quality of the effluent was frequently superior to the quality of water delivered at the consumer's tap. Rusting and clogging of pipes, with resultant red water trouble, bad tastes and odors developing from mud accumulations in dead end pipes, and alarming quantities of lead in the water supplied through lead pipes were some of the problems that have required attention. Although progress in filtration plant design has been going forward for 40 years, the most effective developments in water purification have been made during the last 15 years. The all-important introduction of chlorination in 1908 was one of the most important advances but its universal effectiveness in sterilization actually delayed improvement in other water treatment processes.

Efforts at Providence, R. I., were cited to show how experimentation with pH adjustment made it possible to provide water which helped to end red water trouble, maintain the distribution system free from slime coating or incrustation and remove manganese present in the raw water supply. One advantage of the present treatment is striking, when it is stated that at pH 7.6, using average consumption figures, it meant that approximately 6 tons of iron per year were dissolved in the water but at pH 9.7 this has been reduced to 1½ tons per year.

Besides improvement in water quality for the consumer, changes have also been made which insure the highest possible degree of stability to the existing distribution system. Severe economic losses resulting from depreciation of pipe lines due to corrosion and incrustation have been curtailed.

The characteristics of a soft water which will be of highest quality and least harmful to distribution system were given by the author as follows:

1. pH—9.6 to 9.8—all carbonates will then be present as normal carbonates.
2. Iron—0.05 p.p.m. or less—to prevent deposition of iron hydrate in pipe.
3. Manganese—0 p.p.m.—any manganese present will precipitate as black mud at a high pH and cause black water complaints.
4. Aluminum—0.03 p.p.m. or less—when alum is used as a coagulant to minimize the deposition of a light mud in the pipe.
5. Chlorine—sufficient to give a slight residual of 0.02 p.p.m. in tap water to sterilize the supply and to inhibit bacterial growth in the mains.
6. Temperature—as low as possible for palatability and inhibition of bacterial growth.

A note of warning was sounded in the use of a 9.7 pH water. Zinc is highly soluble in such a water whether hot or cold, and any metal in contact should contain little or no zinc. Lead, iron and copper were stated to be highly resistant to corrosion in water of this high alkaline range.

The construction of a purification plant to treat the water supplied to the cities of Salem and Beverly, Mass., was the topic of an illustrated talk given by Frank A. Marston, of Boston. Designed to treat 6.6 m.g.d. for the 68,430 population of the two communities, this project was successfully constructed during a severe winter season using ERA labor. Although the cost of the plant, $630,000, was greater than if it had been built by contract, the job furnished worthwhile employment to meet local relief needs.

Groundwater symposium

The importance of groundwater supplies in Massachusetts, where one-quarter of the 4,250,000 inhabitants depend in whole or in part on well and spring sources, was reviewed in a comprehensive paper by Francis H. Kingsbury, senior assistant engineer of the state department of health. Material was collected from the files of 129 municipalities who have had experience in developing works for collecting groundwater since public supplies were first introduced, and from this mass of data the author showed certain trends in developments since 1870. Prior to that time springs were the principal means for utilizing groundwater and in the next decade filter galleries were in the majority for new works. Dug wells were the favorite construction between 1881-1890 and since that period tubular wells have been the most popular type of installation.

Experience with groundwater supplies along the sea coast showed that in order to prevent pumping of brackish and saline water there was a critical depth beneath which wells could not be driven because of the balancing effect of the fresh water on the heavier salt-laden water. There was less likelihood of salt water seepage if a system of several wells, driven over a wide area, were utilized rather than placing a heavy draft on one or two wells closely located to each other. Obtaining a suitable supply of fresh water near the sea was found to be essentially a skimming problem and any attempt to skim too heavily or too deeply in one spot had disastrous results.

Geologic features of groundwater supplies, described by Kirk Bryan, associate professor of physiography, Harvard University, emphasized the fact that sand and gravel deposits, though relatively few in number throughout New England, were ideal basins for the collection of water. Wells drilled in rock yielded fair sources of supply from seepage through joint cracks but at depths greater than 250 ft. it was found that

earth pressures closed these fissures and minimized the opportunity for obtaining a reliable yield. Attention was directed to the splendid U. S. Geological Survey maps of Maine and Connecticut showing the distribution of sand and gravel lenses in these states, which have been of great value in locating underground water supplies.

Bayard F. Snow of Boston, described the development of a water supply for a public institution in Massachusetts where a system of tubular wells was connected with a large-diameter dug well which served as a storage basin. In this manner it was possible to limit pumping and at the same time assure an adequate yield.

The use of a hand pitcher pump, commonly adapted for obtaining samples from and determining the yield of an individual well in a well system, was disparaged as giving false and meaningless results in a paper by Paul F. Howard of Boston, who then described a new method for rating and sampling tubular wells under normal operating conditions. Essentially, the method used was to connect a 1¼-in. centrifugal pump to the well tube which discharged through a 2-in. pipe attached to an orifice flow meter and manometer. This accurately recorded the rate of flow. The amount of draw-down of the well when connected to the well field was determined by means of a mercury U-tube attached to the well cap, the tube extending into the well to a depth sufficiently great so that the end was at all times below the level of the water outside the well. Samples of water for analysis are obtained from the pump discharge while the well tests are being made.

Six important steps in developing a groundwater supply by shallow driven wells, outlined by Ralph Horne of Boston, Mass., were as follows:

1. Estimation of the maximum rate of draft which the wells must be able to yield by approximating both the extent of the watershed area which should be tributary to the driven well system and the number of wells needed.

2. Selection of a site adapted for the installation of a driven well system. Topographic maps of the U. S. Geological Survey indicate possible sites, and a field reconnaissance will show where surface conditions are most favorable. Large deposits of sand and gravel and the absence of excessive accumulations of vegetable matter are desirable.

3. Installation of a system of test wells. A tentative layout should include one well near the center of the watershed and others located near the extremities for exploratory purposes.

4. Provide a pumping test of the well to obtain measurements of the lowering of water level.

5. Estimation of the adequacy of the well site for furnishing the required draft of water through draw-down curves and volumetric measurements.

6. Installation of additional wells with the construction of a permanent system of driven wells (spaced 25 to 40 ft. apart) and suction piping, incorporating in the system all the test wells which are suitable for the purpose.

Robert Spurr Weston in discussion described the various methods for removing iron, manganese and carbon dioxide, calling particular attention to the use of pyrolusite, a catalytic medium, which has found favor in Europe and has been recently introduced in this country at the Brainerd, Minn., municipal plant. In this latter installation the raw water is forced upward through a considerable thickness of pyrolusite (a manganese ore containing about 70 per cent manganese dioxide) and the water is then sprayed onto a contact aerator of coke. Here the manganous hydroxide is oxidized and coagulated to form stable manganic compounds, the water having a pH value of 7.2 to 7.3. The efficiency of this form of pretreatment is shown by the removal of 80 per cent of the iron and manganese. The filters remove the small balance remaining.

Superintendents' session

A superintendents' session was opened with the presentation of 20 certificates of award to waterworks superintendents, registrars, and commissioners, who had served the same municipalities for 25 years or more and who have been members of the New England Water Works Association for at least that number of years. This is the first time these awards have been made and it is to be continued as an annual feature.

Illustrative of the problem of municipal decentralization Horace J. Cook, Auburn, Me., recounted the efforts of a small high grade suburb of 90 homes to force the expenditure of $100,000 for main extensions which would produce but $300 gross annual income, entailing a loss of at least $10,000. This would raise the water bill $2 for each of the 4,000 families in Auburn. Requests for PWA money have been agitated but so far the Maine Public Utility Commission has not granted approval.

Sidney S. Anthony, Augusta, Me., reported on a fatal accident to two waterworks employees who entered an old fire protection system abandoned 50 years ago. Decomposing organic matter had produced carbon dioxide to such an extent that the ordinary gas mask of the fire department was not effective. The men entered without taking the precaution of having a rope around their waists.

William F. Sullivan, Nashua, N. H., described the installation of a 6,000,000-gal. diesel-operated centrifugal pump, after comparison had been made with electric drive. Since much of the power used is hydraulic and the new unit will be used only a few months each year, the high electric rate scale was unfavorable to the use of electricity. Had the pump been operated throughout the year electricity would have been the cheaper.

Round-table discussions

Taste and odor control of open reservoirs by the use of copper sulphate, collection of delinquent accounts, and the use of water supply reservations for recreation purposes were topics for discussion led by Harold L. Brigham, of Marlborough, Mass. A dosage of 4 lb. of copper sulphate per million gallons was considered adequate for microorganism destruction in reservoirs, and the application was most effective if made in the early fall before ice had formed. The tax lien law in Massachusetts which permits water bills to be placed with the tax collector for collection has been of assistance in reducing the number of delinquent accounts.

The growing agitation to open watershed preserves for fishing and other recreational uses was described as resulting from a lack of understanding by public officials of the responsibilities involved in supplying pure water. It was pointed out that municipalities are liable for huge damage suits if disease outbreaks develop through the water supply or if accidents occur on publicly-owned property.

In a discussion on meter-testing methods and pipe lengths, conducted by William W. Brush, New York, it was pointed out that careful periodic checking of meters had increased annual revenues $70,000 in one community and $55,000 in another. The viewpoint that meter errors compensate themselves was declared erroneous. Difficulties in transportation and handling were the principal objections to the use of 16-ft. length cast-iron pipe when laying mains in crowded cities having many underground structures. Although the 12-ft. lengths were considered more flexible to use the greater number of joints increased the possibility of leakage.

Service pipe problems and waterworks operating practice discussions were led by W. B. Duffy of North Andover, Mass., and A. A. Ross of Lexington, Mass., respectively.

Howard M. King, in his address as retiring president, urged the members of the association to take a more active part in public life insofar as waterworks relations are concerned as a means of directing greater attention to the important role played by the superintendent in preserving community health.

Officers elected for the coming year were Roger W. Esty, president; Harry U. Fuller and Warren J. Scott, vice presidents; Leland G. Carlton and Frank J. Gifford will continue as treasurer and secretary, respectively. The board of directors are: George A. Sampson, Percy A. Shaw and Harold K. Barrows. Gordon M. Fair continues as editor of the journal.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

Modernizing Buildings

MODERNIZING BUILDINGS FOR PROFIT—By Kenneth Kingsley Stowell. Cloth; 9x12 in.; pp. 231. Photographs and line drawings. Published by Prentice-Hall, Inc., New York, N. Y. $6.50.

Timed admirably to give help to those who may be considering taking advantage of the Federal Housing Administration's modernization efforts, this book, by the editor of *The Architectural Forum*, has been planned to answer many crucial questions. How much modernizing is justified? What is the way to get started? What are the standards by which the modernity of houses, commercial buildings, hotels, theaters, apartments, restaurants and office buildings is measured? Many of the answers are given by means of case histories.

Street Improvement

BUILDING LINES AND RESERVATIONS FOR FUTURE STREETS—Harvard City Planning Studies—Part VIII—By Russell Van Nest Black. Cloth; 7x10 in.; pp. 243. Published by Harvard University Press, Cambridge, Mass. $3.50.

DESPITE the objection in Chicago and other large cities to the extension of extra-width streets because of reported heavy accident incidence, there is need for information on how to acquire right-of-way for the extension and widening of city streets under the innumerable rules, laws and ordinances extant throughout urban America.

The stated purpose of Black's volume on building lines and property reservations is to describe ways of "protecting" future streets and widenings through control of building lines. Practically all city planning, unless it be for that rare fortuitous case of laying out a new city, involves widening or rearrangement of the street pattern wherein land must be acquired. The proposed improvement usually takes many months, even years, and economy is attained if, in the interval between adoption of plan and its accomplishment, buildings can be kept off future public takings. Widely different methods of approach are being employed, and this book tells with what success. Enough experience has been accumulated to present trends and resulting suggestions.

Topics covered in the seven chapters include legislative and administrative aspects, local procedure and experience, eminent domain versus police power, court decisions, economic aspects and conclusions. In the latter the most pregnant thought is that streets adequate in width and plan are essential to community life; hence property owners have the obligation of sharing the responsibilities of community integration of property and of maintaining that integration through the processes of change and development.

In the appendices are model planning acts, excerpts from various state planning acts and city and county ordinances, and a bibliography.

Sedgwick's Classic Revised and Enlarged

Reviewed by M. N. Baker
Upper Montclair, N. J.

SEDGWICK'S PRINCIPLES OF SANITARY SCIENCE AND PUBLIC HEALTH—By Samuel C. Prescott and Murray P. Horwood. Cloth; 6x9 in.; pp. 654. Published by The Macmillan Co., New York. $4.25.

MORE THAN three decades ago Professor Sedgwick wrote a book entitled "The Principles of Public Health." In breadth and depth of knowledge of those human ills within its scope, and of sanitary biology and engineering and the practical applications of all three the book was unexcelled. Added to these high qualities was the rarer one in scientific writings of inimitable facility of language—a quality thousands who have listened to the author in the classroom, on the platform, in private conversation or who have read his numerous addresses and the original of the book now under consideration can never forget.

Considerable portions of Professor Sedgwick's classic are so based on the eternal verities and are so apt in citations showing milestones in sanitary and health progress—like the evolution of the microscope, of bacteriology, of the germ theory of disease, and notable water-borne epidemics—that no revision is necessary. There remains for additional chronicling the march of progress during the past three decades in the fields to which Professor Sedgwick contributed so much in his all-too-short working period. To this end, Dean Prescott and Professor Harwood have given the original work a thorough going over and considerable enlargement. Besides chapters "largely rewritten" they have prepared "fourteen entirely new chapters to cover subjects not included in the original text or which have become obsolete."

Among the chapters largely rewritten, those of most interest to engineers are: "Sewage and Excreta as Vehicles of Disease and Their Proper Disposal"; "Water as a Vehicle of Infectious Disease"; "Protection and Purification of Public Water Supplies"; "Ice as a Vehicle of Disease." Of the chapters revised less extensively is the one on "Dirt, Dust, Air and Disease."

In a field so vast and so rapidly changing it would be amazing if the revision had not overlooked some important matters. Only a few seem to require mention. Under sewage disposal there is not even a hint of the revival of chemical precipitation. In the chapter on water infection the astounding reduction in the typhoid death rate during the past few decades is not sketched. Although statistics on sewage-treatment works are given, no data on water purification have been taken from the Gillespie census of water-purification plants as of 1924 nor the more extensive 1930-31 census directed by Streeter.

Finally, it should be noted that the original edition was written and the present one has been revised with the needs of the sanitary engineer in mind as well as those of public health officials and social works and all "civic-minded men and women who are interested in public health work."

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

CODE-SPONSORING TRADE ASSOCIATIONS—By C. Judkins. Market Research Series No. 4. Paper; 8x10 in.; pp. 105. Published by Bureau of Foreign & Domestic Commerce, Washington, D. C. $ .10.

DESCRIPTIVE GEOMETRY—By Frank W. Bubb. Cloth; 6x9 in.; pp. 234. Published by The Macmillan Co., New York, N. Y. $2.50.

ELEMENTARY STRUCTURAL PROBLEMS IN STEEL AND TIMBER—By C. R. Young. Cloth; 6x9 in.; pp. 315. Published by John Wiley & Sons, Inc., New York, N. Y. $4.00.

THE PORTS OF GULFPORT AND PASCAGOULA, MISS.—Port Series No. 19. Prepared by Board of Engineers for Rivers and Harbors, War Dept., U. S. Army. Paper; 6x9 in.; pp. 100. Tables; maps; photographs. Copies available from Government Printing Office, Washington, D. C. $ .50.

SEEHAFENBAU—Band III: (Lieferung 2 and 3): By F. W. Otto Schulze. Paper; 7x10 in.; pp. 240; diagrams. Published by Wilhelm Ernst & Sohn, Berlin, Germany. Price, RM 5.70 each.

WHAT THE DEPRESSION HAS DONE TO CITIES—An Appraisal by Thirteen Authorities of the Effects of the Depression on Municipal Activities—Edited by C. E. Ridley and O. F. Nolting. Paper; 7x10 in.; pp. 58; Published by International City Managers' Assoc., Chicago. $1.00.

Letters to the Editor

Using Files of Technical Journals Aids Repair Work on Old Dam

Sir—A little experience of mine as resident engineer on repairs to Sewalls Falls Dam on the Merrimac River may possibly interest you. Visiting with an older engineer friend of about 1897 vintage, I mentioned that I was working on a timber dam and wished I knew more about them. In the discussion he dug out his old textbooks, and we found the same dam illustrated, with reference to *Engineering News*, April 19, 1894. My superior on the work, the consulting engineer, had the issue dug up in library files and photostated; it was of considerable use in reference to the repair work. The 1893 contract cost figures were of value in figuring retirement values for the portion of the structure which we renewed.

Port Jervis, N. Y., Aug. 19, 1935. E. M. WILBUR

Error in Deck Width of George Washington Bridge

Sir—In your Aug. 8 issue, p. 180, there are comparative cross-sections of several bridges, shown in connection with the description of the Triborough Bridge.

In this drawing the George Washington Bridge, labeled "Hudson River Bridge" is incorrectly shown. The existing roadways on the bridge are 28 ft. 9 in. wide between curbs and the proposed center roadway is 30 ft. 6 in. instead of 24 ft. and 40 ft. as shown.

New York, N. Y., Sept. 5, 1935. CHARLES CARSWELL, Operating Assistant, Port of New York Authority.

New Am.Soc.C.E. Grade Would Be Meaningless Title

Sir—The letter of William J. Cox in your issue of Sept. 5, relating to the proposal for mass changes in membership grades of the American Society of Civil Engineers is very clear and logical. The point of view therein expressed should be noted by every corporate member before final consideration of this question on Oct. 16.

After careful reading of the proposal and the comments on both sides, the creation of a higher grade of distinction appears justified and a benefit to the society in general. The means, however, is so ill conceived and poorly worked out as to defeat its own avowed purpose. It is not often that such an unfinished proposal is presented by the board of direction for referendum to its membership. The sponsorship of that body has usually been sufficient evidence that proposals for constitutional amendments have been well considered and the details of operation thoroughly planned before presentation. In this instance more than usual scrutiny is necessary to proper judgment.

Throughout the life of the society the grade of member has been sought by engineers from their early years in practice as a mark of distinction worth attaining, despite the fact that it carries no privileges or responsibilities denied to associate members. Lowering the standard of this, the highest grade in the society obtainable by individual effort, is to break faith with tradition and the hopes and aspirations of thousands of young engineers.

If still further distinction is desired, it should be conferred as a result of application and upon examination of professional record. The distinguished member should be exalted to higher honor by recommendation of his peers.

To confer this additional distinction automatically upon 4,906 members on no better basis than a specified duration of practice and five years' dues is contrary to the principles that have established and maintained the society in its present high standard. It would not only be a reversal of the vigilant procedure in effect for generations relating to admissions to membership but would act as a restraining influence to proper vigilance on new applications. Such a course would also be a grave injustice to hundreds of capable and distinguished engineers, who through force of circumstances have honorably withdrawn from membership in order to avoid indebtedness or to live within their means. However distinguished in ability or accomplishments, these men would be required to serve time in order to obtain this contemplated honor at the hands of the American Society of Civil Engineers.

If this amendment is adopted, the grade of "fellow" will fall upon 4,906 members, whether they want it or not, as a meaningless empty title to flatter the vanity of its proponents but in no sense worthy of attainment by others who may be familiar with its origin.

The substantial engineer and citizen who has gone through the various grades of membership and has obtained by his own skill and industry the highest grade in our society requires no additional title to enable him to "go places economically and socially."

The committee of proponents of this new order might tell us what they mean by "places economically and socially denied to engineers" to which admission may be gained by use of the magic title, and how many of the 4,906 would care to go.

Would not the designation Baron, Duke or Earl be a more effective entrée for that purpose?

We cannot ignore the temper and character of the engineers on the mill and in the plain, in the tunnel or on the bridge, the backbone and hope of the engineering profession to whom doing things rather than going places has the greater appeal.

Philadelphia, Pa., Sept. 10, 1935. P. D. G. HAMILTON, Member, Am.Soc.C.E.

Abstract of A.S.C.E. Statements Omits Significant Clauses

Sir—In your issue of Sept. 5 you published a protest of mine against certain features of the amendments to the constitution of the American Society of Civil Engineers, now being voted on. Almost simultaneously, *Civil Engineering* reprinted a sligthly condensed version of the official statements for and against the proposed amendments. This reprinted version omitted certain sentences to which I had referred, principally, "Those sponsoring these amendments believe that admission to the grade of fellow should be on a basis solely of distinction. However, it is recognized that great reforms sometimes can be achieved only by compromise, hence the provision in the amendments for a partial 'grandfather clause' . . ." Also omitted was the sentence: "Architects have been able to go places economically and socially denied to engineers," followed by a rather unconvincing development of this idea into a suggestion that this greater success on the part of architects is in some way a consequence of their calling themselves "Fellows." My letter is obscure except in the light of the original and full committee report. For this reason I think that attention might well be called to these specific omissions.

New Haven, Conn., Sept. 15, 1935. WILLIAM J. COX, Member, American Society of Civil Engineers.

Length of Cross-Florida Canal Could Be Cut 40 Miles

Sir—In your issue of Sept. 5, 1935, you have an article on p. 341 entitled "Sea-Level Canal Across Florida Authorized by the President."

In this article the route of the canal is given as "by way of the St. Johns River from its mouth to Palatka." It would be interesting to some of your readers to learn why it is more economical and better engineering to build and maintain 70 miles of the St. Johns River, from its mouth to Palatka, than to cut into the river from the ocean by a line running approximately due east and west from some point near Palatka. Such a line should save about 40 miles of total distance by cutting out about 60 miles of river line.

Buffalo, N. Y., Sept. 9, 1935. THERON M. RIPLEY, Consulting Engineer.

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A Venture in Sidewalks

THE PEDESTRIAN of the rural road has at last met a generous response to his often-urged demand for a footway that will give him safety from automobile travel. In Massachusetts the last legislature gave the department of public works an appropriation of four million dollars for sidewalks on state roads. To this sum the federal works-relief authorities are being asked to contribute an equal amount. With less than 2,000 miles of state highways this sum will give the state highway engineers upwards of $4,000 a mile and it is anticipated that practically every mile of state highway can be provided with a sidewalk. In any event the foot travelers of the Bay State can be sure that hiking will be made safe on half of the state roads. At present nothing very definite is known of the new sidewalk plans and structure; however the fact of main importance is that pedestrian ways are to be provided in a grand manner as a state highway policy. This is as radical a development as state roadbuilding practice has recorded in a long time. Incidentally one is tempted by the occasion to speculate on the economics and logic from the viewpoint of general road transportation improvement of entering in wholesale manner into rural road sidewalk building. Massachusetts, with a main highway system beaded with settlements, offers a most favorable opportunity for success and its experience will be watched with interest.

Industry Builds Again

INDUSTRIAL BUILDING is looking up. To many, this is the most significant move of the business barometer since the beginning of the depression. In 1933 and 1934, appreciable industrial building advance was experienced, but in one case breweries dominated the upswing and in the other distilleries. Neither represented a broad movement in industrial building, indicative of heavy industry improvement. There is more cause for satisfaction in current statistics. During the first eight months of 1935 industrial building volume was $117,000,000, which may be compared with 166, 93, 152 and 105 millions for the twelve months of 1931, 1932, 1933 and 1934. It is possible that 1935 volume may approach the 1931 figure of $166,000,000. In amount, this is only 60 per cent of the previous ten-year average and only 40 per cent of the 1925-1929 average. But it is in quality, not quantity, that the 1935 industrial building is noteworthy. No one class of building may be said to dominate the list of contracts covering sugar refineries, gasoline cracking plants, paper warehouses, meat-packing plants, bottling works, diesel locomotive shops, chemical plants, steel mills, copper refineries, pulp mills, aluminum plants, farm implement plants, glass plants, woolen mills, breweries and distilleries. It is heavy industry on a broad front that is showing improvement, and it is the same heavy industry whose sluggishness has heretofore opposed all efforts to attain a sustained business revival. The improvement has added significance at the moment, when the effects of poor management of the public works funds are becoming apparent. For the rest of the year the state of industrial building will have increasing relation to the state of general business.

Past Practice or Precedents

THE INCREASED NUMBER of industrial building contracts raises a question as to what form the new structures will take. Will they adhere closely to past practice or will they set precedents? A partial answer is already available in one large development whose steel-frame members bypassed the fabricating shop, to be cut and welded into large buildings in the field. This is new, but it is only one example among many possibilities. How extensively will air-conditioning be used? In what ways will the installation of air-conditioning equipment affect the form and structure of new buildings? Are new materials going to receive attention as in the residential field? Are one-story or multi-story structures to be preferred? What about the windowless building? Or, in contrast, of the glass-wall building? What effect will new industrial processes exert on the structures that house them? Construction has much at stake in the answer to such questions. If industry's building demands have not changed materially, the construction art has merely to begin where it left off five years ago. On the other hand, if industry has developed new wants, design and construction practices must stand ready to satisfy them. There is small reason to fear that such demands as are made will not be met, but it is as well to begin to check available assets in knowledge of material and in design and construction ability before increasing demands make careful study difficult.

Too Ambitious Port Plans

MUNICIPAL PRIDE should not mislead a community into building a water terminal adequate for vessels of deep draft when in reality best interests would be served by a port development designed for vessels of shallower draft. Large vessels requiring a 30-ft. channel depth have an operation cost far too high to permit of calling at a number of terminals to pick up their cargo piecemeal. The minimum quantity of freight that such a vessel can afford to call for may range from 500 to 2,000 tons (according to size of the vessel and other conditions). Money can be saved by rehandling smaller shipments to concentration points. Hence fewer deep-water terminals and more that have facilities for shipping of the size requiring less than a 20-ft. draft would promote water commerce by eliminating the high overhead cost of the large terminal. With 60 per cent of the tonnage moving in vessels of less than 20-ft. draft there should be ample commerce for the port that equips itself with low-cost facilities capable of handling freight being concentrated at the larger ports or freight that can move to its destination in shallow-draft vessels.

An Enviable Record

FOR MORE THAN A CENTURY Congress, in planning for the nation's waterways, has laid upon the Corps of Engineers of the Army the responsibility of investigating proposed work and of carrying on work that it authorized. This year, seemingly in acknowledgment of that long service, Congress named the Corps as the perma-

nent agency to carry forward such work. The service record thus recognized is one of which any body of men may well be proud. Scandal, graft, undue respect for political influence—these stains that frequently mar the record of so many public bodies—are peculiarly absent from this one. Year after year the multitude of schemes for river improvements, harbors and waterways that are pressed upon Congress by their enthusiastic promoters have been referred to the army engineers under whose supervision they have been carefully analyzed, made the subject of public hearings, and, ultimately, the subject of a favorable or unfavorable report to Congress. And not infrequently unfavorable reports have been made in defiance of the demands of politically strong individuals. Though difficult at the time for the officers concerned this firm adherence to the conclusions drawn from an engineering study has benefited the Corps by building up in the minds of Congressmen full confidence in the inherent honesty of that organization. Congress now has written its acknowledgment of that confidence into the law of the land. Engineers in civil life will gladly add their approval, for though they may at times disagree with the army engineers' conclusions or may rebel against their occasional displays of arbitrariness yet they recognize that in the long run the record of the Corps of Engineers is one that does honor to the whole profession.

Risks in Relief Work

THE New England Water Works Association last week set an example for other organizations of similar character in issuing strong protest against the risk involved in constructing or enlarging municipal services with unskilled and poorly directed labor. That such a risk may become widespread is apparent when it is realized that the recent scuttling of the PWA program in favor of a WPA program means that the bulk of the work that will be put on the WPA program this winter will be municipal in nature, work that otherwise might have been on the PWA program, and work that should be done skillfully because it must be secure against failure over a long period of years. Failure under some circumstances may be very serious to the community or to some part of it.

Municipal services should be well built and built with first-class materials. Skimping on either workmanship or labor is poor economy, yet the whole set-up of the WPA tends in that direction. The requirement that all but ten per cent of the labor must come from relief rolls means that the work will be carried on in large part by men unfamiliar with operations that require a considerable amount of skill. The low percentage of WPA funds that may be spent for materials tends to favor the purchase of cheap or inadequate materials.

From another angle, doing the engineering work on works-relief projects with makeshift staffs may introduce hazards through unsafe designs such as those permitting cross connections between polluted waters and domestic water supplies.

Risks are involved in many classes of work that may be undertaken. Dams, for example. Some dams built by the CWA last year were washed out during the past summer. Demolition work, one of the operations put forward as desirable in slum clearance, requires a high degree of skill to avoid accidents. Building work poorly done, especially winter work where concrete is involved, may result in serious failures. Grandstands built as part of the many recreational projects considered for WPA may be a source of very great risk if not properly designed or built.

Such danger possibilities may be minimized by changes in WPA regulations as urged by the N.E.W.W.A. to permit the employment of more skilled labor and more trained supervisors and by a relaxation of limits on money spent for materials and equipment. A still better way would be to put all work involving any considerable amount of engineering back into the PWA where it can be handled under more normal conditions and by normal methods. Doubtless this is too much to be hoped for. Efforts, therefore, must be directed toward modification of WPA regulations and toward recognizing the potential dangers and providing against them.

Four-Lane Road Hazards

ACCIDENT FREQUENCY RECORDS of four-lane highways are bringing a change of thought concerning the design of these wide roads. It is now urged that safety lies in separating the two pairs of travel ways by a parkway that will absolutely prevent cross-over travel. This of course is not new thought but practice has been slow to commit itself for the greater right-of-way and grading costs; accident experience has been necessary to bring conviction that the extra expense is justified if safety of travel is to be assured in four-lane road design.

Two widely separated recent actions by public road officials are pertinent examples. On Indiana's four-lane road that skirts Lake Michigan the hazards of travel have brought an announced policy that the state highway department will build no more four-lane roads without a dividing parkway. Because of nearly similar experience on a portion of its costly Brunswick Pike, New Jersey is planning to split the road in the middle and to slide two lanes of the concrete pavement far enough to one side to provide a separating parkway. The cost is estimated to be $50,000 a mile for eight miles, and this is investment made purely for safety—no more travel space is added.

The hazard of both the Brunswick Pike and the Indiana shore road lay in their temptation to drivers to speed their cars provoking impromptu races that result in cars traveling at excessive speeds cutting into lines of opposing traffic. The records put the fact beyond challenge that the four-lane road can be made safe only by separating its opposite traffic streams. Indiana has decided on this practice as definite policy; New Jersey is finding that its adoption in the first instance would have cost less than the present forced reconstruction. In view of both experiences the road engineer might well ask whether his present four-lane design practice is not open to substantial revision. If four-lane practice is found to be subject to revision the effect must extend down to the three-lane and even to the two-lane road because current practice looks upon the three-lane and two-lane trunk road as but stages in which the ultimate development—the four-lane road—is attained by adding an extra lane or two. But if opposing lines of traffic must be separated in the ultimate development it appears logical to conclude that provision for the separation should be made in initial construction. New Jersey's experiment will throw some light on this point.

CURRENT NEWS

Uncompleted Projects Require Large Sums For Continuation

UNCOMPLETED projects now being carried on by the Bureau of Reclamation and the Corps of Engineers will require funds amounting to over half a billion dollars for completion. For projects now under way by these two agencies a sum of $212,087,000 has already been allotted. The total cost of the projects is to be about $855,190,000, leaving appropriations of $643,103,000 to be made.

On July 16 the Advisory Committee on Allotments earmarked $100,000,000 for projects to be carried out under the Bureau of Reclamation. These funds did not include any allotment for Parker Dam, which had already been started under a previous allotment of $2,000,000.

FUTURE PUBLIC WORKS
Bureau of Reclamation

Project	Relief Funds Allotted	Balance Needed (Unappropriated)
ARIZONA		
Gila	$2,000,000	$18,400,000
Salt River	4,500,000	1,500,000
CALIFORNIA		
All-American Canal	15,000,000	14,500,000
Central Valley	20,000,000	150,000,000
Klamath	135,000	699,000
Parker Dam	2,000,000	11,000,000
IDAHO		
Boise-Payette	1,000,000	3,900,000
MONTANA		
Bitter Root	200,000	175,000
NEW MEXICO		
Carlsbad	1,500,000	1,000,000
UTAH		
Provo River	2,900,000	6,100,000
WASHINGTON		
Yakima-Roza	5,000,000	6,634,000
Grand Coulee Dam	23,000,000	25,000,000
WYOMING		
Riverton	1,000,000	3,770,000
Shoshone-Heart Mountain	1,500,000	5,000,000
Casper-Alcova	10,000,000	3,000,000
Other projects	12,265,000	.....
Total	$102,000,000	$250,678,000

Corps of Engineers

Project	Relief Funds Allotted	Balance Needed (Unappropriated)
Passamaquoddy, Me.	$10,000,000	$26,284,000
Cape Cod Canal, Mass.	5,000,000	21,000,000
Tygart River, W. Va.	2,000,000	3,700,000
Kanawha River, W. Va.	5,508,000	1,857,000
Los Angeles and Long Beach Harbors, Calif.	1,000,000	2,325,000
Chesapeake and Delaware Canal	5,107,000	7,930,000
Gray's Harbor, Wash.	410,000	4,155,000
Mississippi River	26,000,000	67,345,000
Missouri River	11,684,000	27,050,000
Fort Peck Reservoir	21,000,000	33,000,000
N. Y. State Barge Canal	5,000,000	22,000,000
N. Y. and N. J. Channels	2,000,000	25,000,000
Conchas Dam, N. M.	4,500,000	4,191,000
Florida Cross-State Canal	5,000,000	141,000,000
Illinois River	2,500,000	13,030,000
Other projects	3,378,000	4,823,000
Total	$110,087,000	$404,690,000

Atlanta Votes Bond to Finance WPA Sewer Construction

A favorable vote, ratifying a $1,775,000 bond issue in Atlanta, Ga., on Sept. 18, will make possible a 54-mi. system of trunk sewers and five disposal plants. The citizens of Atlanta voted approval of three bond issues; one for $1,000,000 which will be used for financing sanitary sewers and sewage disposal plants, one for $500,000 to be used for financing storm water sewers, and $275,000 for schools.

WPA has already allotted $4,599,076 for sanitary sewers, and with the $1,000,000 now made available work will be started in the near future on a 54-mi. system of trunk sewers and the construction of five disposal plants. According to engineers' reports, the trunk sewer system will be adequate to meet Atlanta's needs for the next 50 years and the disposal plants will be adequate for the next 20 years. In addition to the sanitary sewer system, 10-mi. of storm water sewers will be constructed at a cost of about $2,000,000, for which the city will spend the $500,000 authorized by the bond vote. Under the present system about 16 m.g.d. of untreated sewage is dumped into streams surrounding the city.

For school work, the city has been granted $166,000 by the WPA and only $219,000 of the $275,000 recently authorized has been committed to the school program.

Engineering Schools To Be Accredited

Eighteen colleges and universities in the New England and Middle Atlantic States offering courses leading to an engineering degree have requested the Engineers' Council for Professional Development to consider their engineering curricula for accrediting. The group includes many of the large and important engineering schools in these two regions. As part of its plan to enhance the professional status of engineers the council hopes to promote higher standards of education by studying engineering curricula and accrediting those worthy of recognition. A list of approved institutions will be published for the assistance of those who wish to make use of it.

The plan, similar to that followed by the medical and legal professions, will be put in effect this fall in the New England and Middle Atlantic States, and extended later to other regions. Both qualitative and quantitative criteria will be used as a basis for accrediting. Qualitative criteria will be evaluated through visits of inspection by regional committees of qualified individuals.

The questionnaires which the committee spent over a year developing and which were tried out experimentally in a limited number of schools, are now being distributed to the institutions requesting consideration. The material thus obtained will be analyzed and studied as it is received and will be presented to the regional committees for their consideration prior to visiting the institutions.

Works Program Funds May Leave Margin For Future Needs

(Washington Correspondence)

PRESIDENT ROOSEVELT may have, out of the present relief works program, a sum that may total $500,000,000 for use in the next program which has already been foreseen. Administrator Hopkins says it is too early to discuss what may happen after July 1, 1936, but the President evidently thinks that it's well to be prepared.

The President raised to the limit this week the amount that may be spent for WPA state programs. The law earmarked $900,000,000 of the $4,000,000,000 relief works appropriation for grants (and loans) to states and cities but provided that this or any other item might be raised to the extent of 20 per cent of the total appropriation, or by $800,000,000.

The President's order makes available for direct distribution among the states $1,800,000,000. This category includes both WPA and PWA projects. The President has approved, to date, grants for PWA projects amounting to $126,719,259 and has indicated that Administrator Ickes will be allowed to spend $200,000,000 more. This throws to Mr. Hopkins the difference between the PWA total and $1,800,000,000, or $1,373,280,741, plus so much as the President chooses to spend out of $300,000,000 separately earmarked by the law for projects of the type using professional and clerical persons.

Allotments to date

Allowing the maximum for PWA and WPA grants, allotments from the $4,000,000,000 relief works fund to Sept. 23 totaled approximately $3,500,000,000, as follows:

WPA	$1,373,280,741
PWA	326,719,259
PWA housing	100,000,000
Highways and grade-crossings	500,000,000
CCC	597,000,000
Federal projects	575,323,000
Administrative expenses	31,958,137
	$3,504,281,137

This federal expenditure may be supplemented by approximately $500,000,000 by local contributions to WPA's state programs and by loans to supplement PWA's 45 per cent grants of the cost of projects.

Previous allotments cut

In order to use his leeway of $800,000,000, in the $4,000,000,000 relief works program, the President slashed funds earmarked by the law for other purposes: Highway construction and grade-crossing elimination from $800,000,000 to $500,000,000; housing from $450,000,000 to $100,000,000. He has indicated that the Resettlement Administration and the Rural Electrification Administration would also

have their allotments trimmed. The law earmarked $100,000,000 for rural electrification but numerous projects which Morris Cooke has in hand have not materialized in any allotments to date. An early order allocated $91,000,000 for Tugwell's Resettlement Administration but actual allotments, so far as can be ascertained, amount to $7,000,000 for rural rehabilitation, $2,000,000 for farm debt readjustments and $22,000,000 for retirement of submarginal land.

When the relief works bill was before Congress last Spring, the President quashed an insistent demand for appropriation of specific amounts for specific purposes by furnishing his leaders with a schedule that could be contracted or expanded at will. Hopkins hinted a few days ago that there may be some money left and an approximate check-up discloses that the surplus may be $500,000,000 after providing nine months' employment to 3,500,000 men from relief rolls.

WPA hours shortened

Regardless of the conditions of employment, the type of work and the amount of wages actually paid on WPA jobs, union labor has succeeded in protecting its wage scales to some extent. The compromise reached by the rival building trades departments of the A. F. of L. with Administrator Hopkins, is further evidence that organized labor will not contribute to any reduction in building costs that might help in reviving private construction.

While Hopkins has stuck stubbornly to his schedule of security wages which reach a peak of $55 a month for common labor, $65 for intermediate work, $85 for skilled work and $94 for technical and professional work, the WPA administrator consented to rescind his order of Aug. 8 which established a uniform minimum of 120 hours a month. His state administrators have been authorized to fix such minimum hours as local conditions warrant. The effect of such latitude is to bring hourly rates on WPA jobs more nearly in line with prevailing rates.

The unions aren't satisfied with this concession and Hopkins himself apparently doesn't think that this will be the end of his tussle with them. Asked whether the local option on hours will end the controversy his reply was that it would substantially do so. The unions scored on him when he ruled, Aug. 17, that the U. S. Employment Service should furnish contractors with union labor on relief rolls from lists furnished by the unions.

Milwaukee Short of Housing In Low Rent Group

If Milwaukee, Wis., puts through its proposed demolition of 16,000 dilapidated buildings an acute shortage of low-rent quarters will result. Over a period of 12 years less than 15 per cent of the new house construction was for the low-wage group comprising 66 per cent of the population. Since January 1932 nearly 1,200 units housing 5,000 people have been torn down. In 1933 109 living units were added and in 1934 200, and 200 so far in 1935 but little of this building was in the low-rent class. Building inspector, L. M. Gurda in a recent report to A. R. Clas, PWA director of housing, estimated that 5,784 families were without housing facilities and are living "doubled up" with relatives.

BOULDER DAM AS IT WILL APPEAR ON COMMEMORATIVE STAMP

This view of Boulder Dam will be the subject of the commemorative stamp to be released by the Post Office Department on Sept. 30 to celebrate the official dedication of the dam which will take place on that date. The power houses have not been completed but have been drawn here as if completed.

Official figures indicate that Boulder Dam will impound 30,500,000 acre-ft. of water in a lake 115 miles long, with a maximum depth of 590 ft. There will be 9,500,000 acre-ft. reserved for flood control. The dam is 726 ft. high and is 660 ft. thick at the base. In building the dam and appurtenant works, 4,360,000 cu.yd. of concrete were used. Concrete was first placed on June 6, 1933, the gates were closed on Feb. 1, 1935, and the last concrete was placed May 29, 1935. Spillway capacity is 400,000 sec.-ft. The total capacity of the power plant is 1,835,000 hp.

Hopkins Approves Flood Control Project On the Brazos River in Texas

THE Brazos River, Tex., flood control project for which an allotment of $30,000,000 is sought, has been recommended to President Roosevelt by WPA Administrator Hopkins. The project, which was recommended on Sept. 16, calls for the construction of twelve dams on the middle reaches of Brazos River for flood control and irrigation. Future development of the project for the production of hydroelectric power is also contemplated. Sponsors say that the per man year cost of the work will be about $575.

Accompanying the approval of the application are requirements that a number of alterations be made in the Texas law creating the conservation and reclamation district. In order to meet some of the objections that have been advanced by Mr. Hopkins, it will be necessary to permit the state tax diversion fund to be used for the discharging of bonds so that they might be issued to any other agency than a federal agency. It will also be necessary to remove the clause from the enabling act restricting labor to Texas citizens, and it will be necessary to permit the remissions of state taxes of $309,000 to be scaled down and released to the district in case the full $30,000,000 is not finally made available.

Caballo Dam negotiations

The Reclamation Bureau is negotiating with the state department for the transfer of $1,500,000 from the Rio Grande River rectification fund for construction of Caballo Dam, N. M., and has applied for an additional $1,000,000 from work relief funds to raise the height of the projected dam. An allotment of $100,000 has already been made to the Reclamation Bureau and it is expected that $900,000 will be allotted in the future. This would make the total cost of the dam $2,500,000. It is pointed out that the Caballo Dam will fit in with a proposed $4,000,000 hydroelectric project at Elephant Butte Dam.

The Caballo Dam will be built 22 miles below Elephant Butte and will have a storage capacity of about 300,000 acre-ft. The Caballo Dam will catch the waters used in the proposed hydroelectric development and conserve them for irrigation purposes. Originally, under treaty with Mexico, the International Boundary Commission was to construct a smaller Caballo Dam, with a capacity of 100,000 acre-ft., solely for flood control purposes.

Nogales floodway

An allotment of $110,000 from old public works funds to the International Boundary Commission, State Department, to complete construction of an international flood waterway at Nogales, Ariz., and Nogales, Sonora, Mex., and to improve existing channels to carry off flood waters in the region has been made by the PWA.

National Labor Relations Board Completes Rules and Regulations

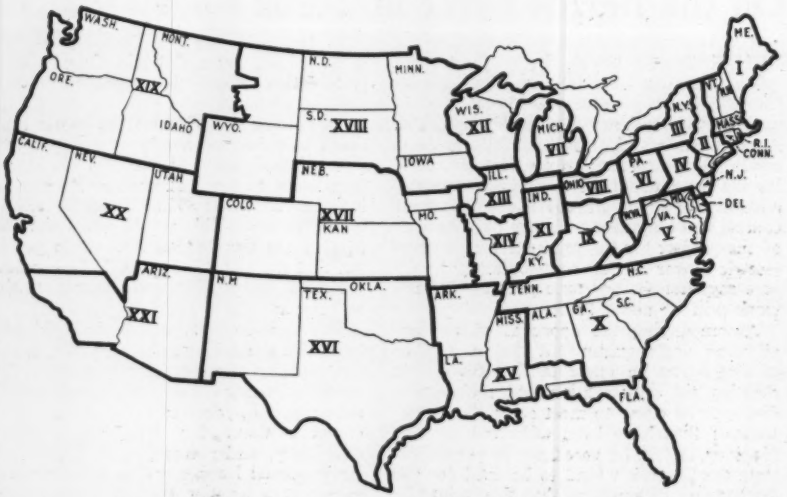
THE personnel of the twenty-one regional offices of the National Labor Relations Board was announced on Sept. 19. With few changes, the cities selected for field agencies are those where offices were established by the former Labor Relations Board. Under provisions of the Wagner-Connery Act, which provides for the setting up of the National Labor Relations Board, both the Washington and the field staff of the former board have been transferred to the new board.

The regional directors and attorneys are authorized to prosecute inquiries, investigate employee representations, and to gather information on alleged unfair labor practices and to hold hearings on the complaints. The regions are shown in the accompanying map.

Under the Labor Relations Act a charge that any person has engaged in unfair labor practice affecting commerce may be made by any person or labor organization, but once the charge has been made it may not be withdrawn except with the consent of the regional director with whom the charge was filed. The charge must be made in writing to the regional director. After a charge has been filed, if it appears to the regional director that a proceeding should be instituted, he serves upon the party to the proceedings a formal complaint in the name of the board stating the charges and containing a notice of hearing before a trial examiner. If the regional director declines to issue a complaint, the complainant may obtain a review of such action by filing a request with the board in Washington.

After the complaint has been served, the respondent has five days in which to submit a written answer to the complaint, specifically admitting or denying each of the facts alleged in the complaint. Any person or labor organization desiring to intervene in any proceeding may file a motion in writing with the regional director who issued the original complaint. The regional director or the trial examiner may permit the intervention to such extent and upon such terms as he thinks wise. Any member of the board may issue subpoenas requiring the attendance and testimony of witnesses and the production of any evidence, including books, records, correspondence, or documents, that are relative to the matter under investigation. The trial examiner shall have power to call, examine and cross-examine witnesses and to introduce documentary or other evidence.

After a hearing for the purpose of taking evidence upon a complaint the trial examiner shall prepare an intermediate report, which is filed with the regional director issuing the complaint. A copy of the report is to be sent to the board in Washington. The report is to contain the findings of fact and recommendations as to the disposition of the case. Any of the parties may file exception to the intermediate report within ten days. The board then may decide upon the case or may conduct further hearings on the matter. The board may also conduct secret balloting where it is deemed necessary for the protection of employee representatives. The board holds that the rules and regulations shall be liberally construed to effectuate the purposes and provisions of the act and it also reserves the right to amend or rescind any rule or regulation at any time.



NATIONAL LABOR RELATIONS BOARD REGIONAL PERSONNEL

Region	Director	Office
I	M. J. McCartin	Boston, Mass.
II	Mrs. E. M. Herrick	New York City
III	J. P. Boland	Buffalo, N. Y.
IV	S. W. Root	Philadelphia, Pa.
V	B. F. Schauffler	Baltimore, Md.
VI	C. S. Golden	Pittsburgh, Pa.
VII	F. H. Bowen	Detroit, Mich.
VIII	R. A. Lind	Cleveland, Ohio
IX	S. B. Mathewson	Cincinnati, Ohio
X	F. E. Coffee	Atlanta, Ga.
XI	R. H. Cowdrill	Indianapolis, Ind.
XII	N. S. Clark	Milwaukee, Wis.
XIII	P. A. Donaghue	Chicago, Ill.
XIV	H. T. Garvey	St. Louis, Mo.
XV	C. H. Logan	New Orleans, La.
XVI	E. A. Elliott	Fort Worth, Tex.
XVII	G. O. Pratt	Kansas City, Mo.
XVIII	R. M. Gates	Minneapolis, Minn.
XIX	C. W. Hope	Seattle, Wash.
XX	R. G. Wagenet	San Francisco, Calif.
XXI	T. J. Nylander	Los Angeles, Calif.

SOCIETY CALENDAR

AMERICAN WELDING SOCIETY, fall meeting, Chicago, Ill., September 30 to October 4.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, Milwaukee, Wis., October 7-10.

NATIONAL SAFETY COUNCIL, annual congress, Louisville, Ky., October 14-18.

PUBLIC WORKS ENGINEERING CONFERENCE, joint meeting of the American Society of Municipal Engineers and International Association of Public Works Officials, Cincinnati, Ohio, October 14-16.

INSTITUTE OF TRAFFIC ENGINEERS, sixth annual meeting at Louisville, Ky., October 15-16.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Birmingham, Ala., October 16-18.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, White Sulphur Springs, W. Va., October 16-18.

CANADIAN INSTITUTE ON SEWAGE AND SANITATION, annual convention, Toronto, Ont., October 17-18.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS, first annual convention, Columbus, Ohio, October 23-25.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual meeting, Columbus, Ohio, October 23-25.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual convention, Miami, Fla., December 9-12.

NEW ENGLAND AND NEW YORK STATE SEWAGE WORKS ASSOCIATIONS, joint meeting at Schenectady, N. Y., October 4-5.

NORTH DAKOTA WATER AND SEWAGE WORKS CONFERENCE will be held September 30-October 1 at Grand Forks. An operators' water and sewage school is scheduled for the second day. M. D. Hollis, Bismarck, is secretary.

WISCONSIN SECTION AMERICAN WATERWORKS ASSOCIATION, annual meeting, Sheboygan, Wis., November 4-6.

EXAMINATIONS for registration of structural engineers and land surveyors will be held in the near future as follows:

CALIFORNIA—By California Board of Registration for Civil Engineers at State Bldg., Los Angeles, and at State Office Bldg., Sacramento, October 24-25.

Washington Highlights

By Paul Wooton

War in Europe means a business boom in the United States. Economists in Washington are agreed as to that. They point out that wide fluctuations will take place on the speculative markets but if war starts all countries in their nervousness will begin to stock up. This will create a demand for a wide range of commodities that will be hard to fill.

War possibilities have stimulated an intensive study by government tax experts of special levies calculated to take the profits out of war enterprises.

Three contingencies, within range of possibility, might require tax legislation at election-year session of Congress. They are: Elimination of processing taxes: slump in government bonds; necessity for arms expenditures.

Appointment of Marriner S. Eccles as chairman of the Board of Governors of the Federal Reserve System is believed to mean that a vigorous policy looking to the encouragement of construction will be pursued by the Federal Reserve Board which has broad new powers over money and credit.

September 24, 1935

Government Will Not Oppose Review Of Decision on TVA Constitutionality

BELIEVING that a Supreme Court ruling on the right of Tennessee Valley Authority to sell power will clear the air of all doubts as to the constitutionality of its actions, the Government is not opposing the request of certain minority stockholders of the Alabama Power Co. for a review of the famous Grubb decision, later reversed by the U. S. Circuit Court of Appeals, which upheld both the TVA Act and the specific transaction involved in the case. This involved the sale by the Alabama Power Co. of certain transmission lines to the authority.

In a brief filed with the Supreme Court on Sept. 17 the U. S. Government contended that its right to dispose of surplus power is no novel question, having been the unquestioned practice of the Reclamation Bureau for many years. Such action is consonant with the prevention of waste of natural resources embodied in the national policy of conservation, it points out.

Alabama city files brief

Stating that there is no doubt that the city of Florence, Ala., as a municipality is, under the statutes and constitution of Alabama, authorized to engage in the business of the manufacture and distribution of electric power, nor that it is authorized and empowered to borrow money to construct distribution systems, nor that federal agencies have a right to make loans for such a purpose, a brief has been filed stating the position of the city in the pending Supreme Court case brought by stockholders of the Alabama Power Co. to challenge the proposed sale of a transmission line by the company to TVA, and questioning the right of the latter to engage in the power business.

The brief confined itself to the right of the complainants to sue the city, stating that other questions do not involve the city.

Request for injunction

Another request for an injunction to restrain PWA from making a loan to a municipality was filed on Sept. 17 in the District of Columbia Supreme Court by the Birmingham Electric Co. It concerns a proposed PWA loan of $1,238,182 to construct a distribution system and 50 mi. of transmission line connecting Bessemer, Ala., with the TVA system. This construction, the petition states, would destroy the value of the company's property in the Birmingham suburb, where it has operated for 45 years.

TVA and Aluminum Company confer

Representatives of the Tennessee Valley Authority and the Aluminum Company of America conferred in Knoxville, Tenn., on Sept. 17 regarding the effect of recent TVA amendments upon the company's development of the Little Tennessee River, where it already has three power dams. The operation of these units and any proposed plans for further development were subjected to TVA control at the last session of Congress. No announcement was made of the result of the meeting.

Representing the aluminum company were: Arthur V. Davis, chairman of the board; I. W. Wilson, vice-president; J. P. Growdon, assistant chief hydraulic engineer; George R. Strandberg, consulting engineer. TVA attendents were: Arthur E. Morgan, chairman of the Authority and chief engineer; C. A. Bock, assistant chief engineer; S. M. Woodward, chief water control planning engineer; B. M. Jones, construction engineer; Llewellyn Evans, chief electrical engineer, C. E. Blee, hydraulic engineer; Herbert Marks, assistant to the chairman.

Manufacturers Elect Directors To AWWA Board

At a meeting of the executive committee of the American Water Works Manufacturers Association, held Sept. 18 in Providence, R. I., three representatives of the manufacturers were named as dirctors of the board of the American Water Works Association, as follows: Dennis F. O'Brien, who is at present a director and whose term is to end in 1939; John A. Kienle, whose term ends in 1938; Guy C. Northrup, whose term ends in 1937. Formerly, the manufacturers named one director only.

Important Railway Construction Being Undertaken in Mexico

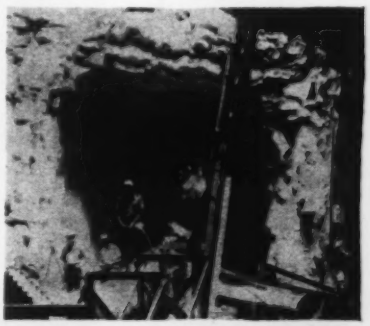
Four important railroads are now being constructed by the National Railways of Mexico, according to reports by the ministry of communications and public works. Among these roads is the southeastern railway that will connect Yucatan, Campeche and Tabasco states with Mexico City. Another line will run from Uruapan, Michoacan, to Zihuatanejo, a Pacific coast port of Guerrero. The others will be from Ejutla, Oaxaca, to Chachahua Bay, on the west coast, and from Suchil to Montaña in Durango.

In this work, the railways are employing more than 100 engineers, 500 clerical workers and 5,800 laborers. The construction work is to be speeded up at the end of the rainy season in late October. The ministry also announced that concessions have been granted for building and operating the following railroads:

An interstate line, 425 kilometers long, between Chiapas and Tabasco; another interstate route, 34 kilometers long, between Michoacan and Mexico states, and a line 30 kilometers long in Vera Cruz state. Work on these railways is scheduled to start before the end of this year.

WHERE PINE VIEW DAM WILL STORE OGDEN RIVER WATER

Two views of the work being carried out at the Pine View damsite on the Ogden River, Utah, project, where the bureau of Reclamation is building one of eleven storage dams to supplement water supplies for existing irrigation projects. The total cost of the project, which will include the relocation of two highways and construction of a pipe line and two canals, as well as the dam itself, will be about $3,000,000. Highway relocation work and the laying of the pipe line has already been started. The lower photo is a general view of operations being carried out at the site of the dam and shows the area that will be inundated when the project is complete. The smaller photo shows the diversion tunnel which was drilled through solid rock to carry the waters of the Ogden River around the damsite. The large pipe shown will deliver water to the city of Ogden.



Large Expositions Planned at San Francisco and New York

Plans for two large expositions are beginning to take definite shape, one on the Pacific Coast at San Francisco in 1938 and one at New York in 1939.

An organization has been formed and plans are well along looking to an exposition to be held at San Francisco in 1938 celebrating the completion of the two bridges on San Francisco Bay, one across the Golden Gate and one from San Francisco to Oakland by way of Yerba Buena Island. The site selected for the exposition is on shoal lands which will be filled in just north of Yerba Buena Island. An area of 385 acres at this location, formerly owned by the state, has been turned over to the city of San Francisco for reclamation. The area is to be used first for exposition purposes and thereafter to be developed as a municipal airport for San Francisco.

In general, the financial program is that San Francisco make application for federal funds (which has been done) to meet a definite percentage of the reclamation cost, the remainder to be raised by the exposition company. Tentative plans call for a rock bulkhead or sea wall around the area to be reclaimed and a 20,000,000-cu.yd. fill made with material dredged from the Bay bottom. Reclamation is to include the dredging of a navigable channel between the reclaimed area and Yerba Buena Island and the construction of a causeway 110 ft. wide connecting the area with the island and thence to the Bay bridge.

At New York plans are just beginning to take form for an exposition in 1939 to commemorate the sesquicentennial of the establishment of the United States Government and the inauguration of George Washington as President at New York in 1789. The board of estimate of the city has voted to cooperate with an exposition corporation and has authorized use of city lands in the Flushing Bay area. As at San Francisco, the federal government will be asked for funds to reclaim much low land adjoining the bay.

WPA Funds Allotted For Newark Airport Improvement

An allotment of $3,400,000 has recently been made by the Works Progress Administration for improvement and expansion at the Newark, N. J., airport. The city of Newark is to contribute $614,000 for the project in addition to the WPA grant.

According to present plans, the four hangars which are now located near the new administration building and which obstruct the landing field to a considerable extent, will be demolished. The funds which have been allotted are to be used to enlarge the field by about 50 per cent and to install a new drainage system. A main runway, which is to be 5,000 ft. long, is included in the new plans. A secondary runway of lesser length and a new hangar are also to be constructed. Engineers are working on final plans so that work on the project may be gotten under way before cold weather sets in. The project is estimated to require about one year for completion, and is expected to employ between 3,200 and 3,500 men.

Chicago Land Use Survey to Be Handled by Plan Commission

Culminating fifteen months work of the Chicago Metropolitan Housing Council in setting up the technical aspects of a program for a land use survey representatives of the city and county have joined in WPA applications for $1,124,000. The Chicago Plan Commission has assumed sponsorship with Col. A. A. Sprague, chairman of the commission to be general superintendent.

The land use survey is estimated to require 12,000 man-months of work for relief clients. Approval of the project by WPA and other technical reviewers has been facilitated by the housing council's close cooperation with the research divisions of the federal departments involved. Both FHA and FERA have detailed staff men to adjust the proposal so as to make other federal studies like the real property survey unnecessary in Chicago. The land use survey covers commercial and industrial properties as well as residential covered by the real property surveys. A logical long term housing program for Chicago based on factual data following the findings of this survey is the ultimate result desired.

The questionnaire and program for the survey was worked up by a technical board of the council, Jacob L. Crane, consulting engineer, chairman, Coleman Woodbury, director of National Association of Housing Officials, J. L. Jacobs, consulting engineer and former assessor Cook County; Louis Wirth, member of the University of Chicago community research committee; W. W. DeBerard, associate editor of *Engineering News-Record*. An advisory committee of business men interested in the finding of the survey is being set up so as to insure the use of the data obtained.

Personals

ROY NUNN, Whatcom County engineer, Bellingham, Wash., has been named engineer in charge of Bellingham projects for the WPA. He will take a year's leave of absence from his present position.

C. WELLINGTON KOINER, city manager of Pasadena, Calif., has been appointed as consulting engineer for PWA's new power division. During the war he served as power expert for the U. S. Shipping Board. In 1921 he became city manager of Pasadena, serving until 1925 and again from 1933 until the present time.

T. BEALE SMITH, maintenance engineer for the Kentucky state highway department, has been named as state procurement officer for state parks. Mr. Smith has been with the highway department for several years. He will act as procurement officer in conjunction with his duties as a highway engineer.

SETH M. VAN LOAN has been appointed as chief of the Philadelphia, Pa., Bureau of Water. Mr. Van Loan has been in the city service since 1901 when he was assistant engineer on construction work for the bureau of filtration. The bureau of filtration was merged with the bureau of water in 1908 and he later became superintendent and deputy chief.

A. H. HINKLE, former state engineer for the Public Works Administration of Indiana, has been appointed as head of the Kentucky Rock Asphalt Institute, recently organized by rock asphalt production companies of Kentucky. Coincident with his work as research engineer for the Kentucky Rock Asphalt Co., Mr. Hinkle has also served as deputy highway commissioner of Ohio and superintendent of maintenance of the Indiana State Highway Commission.

LEWIS V. CARPENTER, head of the civil engineering department of the University of West Virginia, will become associate professor of sanitary engineering at New York University. Professor Carpenter will take up his new duties in September.

CHARLES E. KELLOGG has been appointed principal soil scientist and Chief of the Soil Survey Division, Bureau of Chemistry and Soils, U. S. Department of Agriculture, to succeed Dr. Curtis F. Marbut. Before joining the Department of Agriculture Dr. Kellogg was professor of soils at North Dakota Agricultural College, and prior to that while at Michigan State College, he engaged in research on soil mechanics, particularly in relation to the comparative value of different soil types for use as subgrades in road building.

Dean C. C. Williams of Iowa Appointed President of Lehigh

Clement Clarence Williams, dean of the College of Engineering at the University of Iowa, has been elected president of Lehigh University to succeed Dr. Charles Russ Richards, who recently resigned. Mr. Williams graduated from the Southern Iowa Normal School in 1900 with a degree of bachelor of science and in 1907 received his degree of bachelor of science and civil engineering from the University of Illinois. From 1907 until 1914 he was on the faculty of the University of Colorado as an instructor and assistant professor of civil engineering. He then went to the University of Kansas as professor of railroad engineering and in 1918 became head of that department. Prof. Williams was made head of the civil engineering department of the University of Illinois in 1922, and in 1926 went to the University of Iowa as dean of the college of engineering, which post he now relinquishes to become president of Lehigh University.

Obituary

VAN CLEVE O. MOTT, 61, Buffalo, N. Y., an engineer for 40 years with the New York Telephone Co. in western New York, died Sept. 12. He was born in Buffalo and graduated from Cornell University in 1895. Since 1920, he had been in charge of all construction work for the company in western New York.

EDWARD C. JORDAN, former city engineer of Portland, Me., and in earlier life assistant resident and locating engineer of the Central and Northern Pacific railroads, died at his home in Portland on Sept. 15. He was born in Deering, Me., 89 years ago and was educated at Union College, Schenectady, N. Y.

JOSEPH S. RUBLE, project manager for

the Federal Emergency Housing Corp. at Cleveland, Ohio, died at Preston Springs, Ont., Sept. 4. Mr. Ruble had been vice-president of the Austin Co., Celevland, from 1913 to 1922 when he resigned to take a similar position with the H. K. Ferguson Co. with whom he was associated for many years.

A. P. WENZELL, who for several years had been special engineer on terminal activities and waterway developments for the New York Central R.R., died at his home in Chicago, Sept. 22. Mr. Wenzell, who was 50 years old at the time of his death, had served with the Corps of Engineers during the war. He was a graduate of the University of Michigan and later became locating and construction engineer for several Canadian railways. After the war he became special construction engineer for the Michigan Central R.R. at Chicago and later became connected with the New York Central R.R.

JAMES L. CAREY, architect and engineer of Chicago, Ill., died Sept. 9 at his summer home near Kenosha, Wis. Mr. Carey was born in 1864 and graduated from the University of Wisconsin in 1888 with the degree of mechanical engineer. After leaving the university he was employed by the Black-Clawson Co., Hamilton, Ohio. Mr. Carey, who specialized in the design of paper mills, since 1907 had designed a number of such mills, including the American Coating Mills, Elkhart, Ind.; the Ogden and Cincinnati mills of the Container Corp. of America; the Consolidated Paper Co., Aurora, Ill., as well as paper mills in Melbourne and Sydney, Australia; Tientsin, China, and Warrington, England.

CONSTRUCTION STATISTICS OF THE WEEK

HIGHER state and municipal awards, led by highway contracts, raise this week's total of engineering construction to $27,755,000. Of this amount $3,694,000 is private, $24,061,000 public of which $3,741,000 is federal and $20,320,000 state and municipal. Corresponding awards a year ago are: total, $26,605,000; private, $2,549,000; public, $24,056,000; federal, $7,012,000; state and municipal, $17,044,000.

Highway awards jumped to $10,115,000 this week and public buildings went up to $6,215,000. Other classes of work held about the same as a week ago except earthwork, drainage and waterways, which are off to $2,251,000.

The larger awards include: municipal electric light and power plant, including distribution system, Jamestown, N. Dak., $745,000; heating plant and gymnasium at Brooklyn College, Brooklyn, N. Y., $1,176,000; two contracts, Barge Canal work, New York, $525,000 and $540,000; frequency changer set for Dept. Water and Power, Los Angeles, Calif., $687,000; modernizing city zoo, Buffalo, N. Y., $874,000; 500 miles of distribution lines for Central Hudson Gas & Elec. Co., Poughkeepsie, N. Y., $900,000. Highway awards include: $582,000 by Illinois; $1,010,000 by Indiana; $1,197,000 by New York; $678,000 by North Carolina; $610,000 by South Dakota; $655,000 by Washington. Federal awards include: dredging Whiskey Bay Pilot Extension Channel, U. S. Engineers, New Orleans, La., $406,000.

The new capital curve continues its perpendicular rise as the PWA and WPA allotment approvals are put through to clear the President's schedule. State and municipal bond sales are higher at $14,186,000 which includes $1,215,000 in PWA bonds.

CONTRACTS

(Thousands of Dollars)

	Weekly Average Week Sept. 1934	Prev. 4 Weeks	Sept. 26 1935
Federal Government	$4,256	$9,739	$3,741
State and municipal	15,021	14,629	20,320
Total public	$19,277	$24,368	$24,061
Total private	4,333	4,138	3,694
Week's total	$23,610	$28,506	$27,755
Cumulative to date: 1934	$1,034,528,000	1935	$1,017,041,000

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

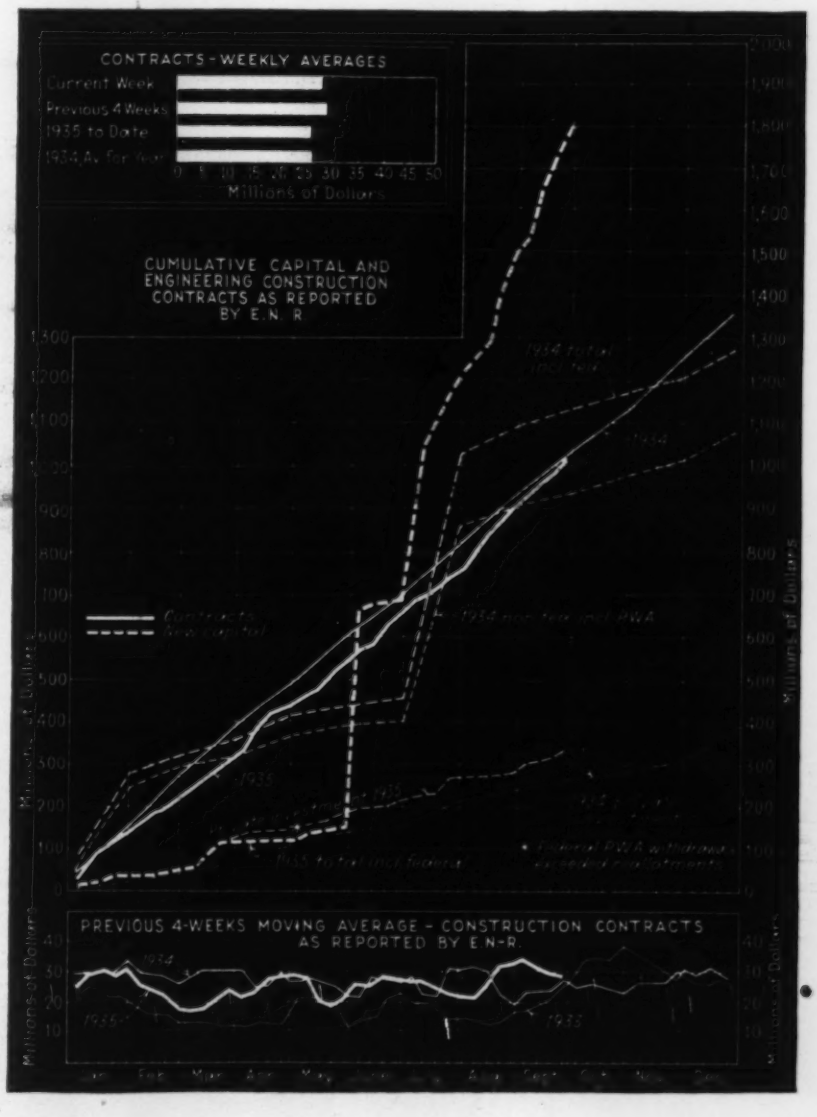
1935	Week Sept. 26	Cumulative
State and municipal	$14,186*	$312,313
PWA allotments, S&M.	98,105*	500,934
RFC loans, S&M	.....	36,084
Corporate issues	200	23,189
PWA private	.....	8,629
Local contrib. to WPA.	3,518	17,548
Total non-federal	$116,009	$ 898,697
PWA federal	68,541	1,009,849
Total new capital	$184,550	$1,908,546
Cumulative to date: 1934	$1,132,453,000	1935	$1,908,546,000

*Includes transfer from PWA to public investment through RFC, sale of PWA bonds.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for federal construction, deficiency act funds. An arbitrary percentage (25%) of the WPA allotments and local contributions to WPA work is included to allow for the capital additions through the Works Progress Administration division of the new program.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Sept., 1935	195.10	93.82	Aug., 1935	140	61
Aug., 1935	195.10	93.82	July, 1935	96	42
Sept., 1934	200.58	96.41	Aug., 1934	94	41
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56


CONTRACTS - WEEKLY AVERAGES
Current Week
Previous 4 Weeks
1935 to Date
1934 Av. for Year
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY E.N.R.
Millions of Dollars
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY E.N.R.
Millions of Dollars

Current Construction Unit Prices

Seminoe Dam and Power Plant

THE Seminoe concrete arch dam, with power plant combined, is proposed for construction on the North Platte River in Wyoming, above the Pathfinder dam, four bids being received July 22, 1935 and award made Aug. 29, 1935. The crest will be 540 ft. in length and 260 ft. above from the lowest point of foundation. A power plant containing three 14,000-h.p. units will be constructed at the toe of the dam, served by three 120-in. penstocks. The power plant structure will be of reinforced concrete on concrete piers extending to bed rock, consisting of a main building 46x128 ft., with an extension at one end, 46x30 ft. A concrete-lined spillway tunnel, 520 ft. long with a 30-ft. circular cross section is to be constructed through the east abutment of the dam, the downstream portion to be used as part of the river diversion during construction, by connecting to it a temporary tunnel leading from the river above the dam. The government furnishes f.o.b. Parco, Wyo. all materials, except sand and gravel.

The following tabulations list the total and unit bids of the three low bidders. (A) Winston Bros. Co., Minneapolis, Minn., in combination with Utah Construction Co., Bechtel Co., Morrison-Knudsen Co., and Henry J. Kaiser Co., $2,194,-007 (contract); (B) J. C. Maguire Construction Co., Butte, Mont., $2,638,073; (C) W. E. Callahan Construction Co., Dallas, Texas, combined with Gunther & Shirley, $2,665,285. H. W. Bashore is construction engineer for the Bureau of Reclamation, which has charge of the project.

SEMINOE DAM AND POWER PLANT

Item	A	B	C
1 Diversion of river	$65,000.00	$16,145.00	$50,000.00
2 Strip sand and gravel deposits—130,000 cu.yd	.12	.175	.12
3. Exca. strip canyon walls—9,000 cu.yd	3.00	6.00	6.20
4. Excav., common, spillway—1,100 cu.yd	.80	1.22	.66
5. Excav., rock, spillway—27,000 cu.yd	1.50	4.00	1.65
6. Excav., tunnel—22,000 cu.yd	8.00	20.00	12.40
7. Excav., common, dam and power house—95,000 cu.yd	.75	1.50	1.40
8. Excav., rock, dam and power house—100,000 cu.yd	2.40	2.50	2.73
9. Excav., common, tailrace—50,000 cu.yd	.75	1.00	1.00
10. Excav., rock, tailrace—25,000 cu.yd	2.00	2.00	2.83
11. Excav., common, roads—9,300 cu.yd	.80	1.00	.50
12. Excav., rock, roads—11,400 cu.yd	1.80	3.00	1.50
13. Gravel surfacing, roads—260 cu.yd	2.50	2.00	3.30
14. Back fill—5,600 cu.yd	.75	.50	1.10
15. Riprap—1,000 cu.yd	2.00	.50	1.65
16. Rubble masonry—330 cu.yd	10.00	10.50	9.00
17. Drill grout holes, under 25 ft.—4,600 lin.ft	1.50	1.00	3.05
18. Drill grout holes, under 50 ft.—1,400 lin.ft	2.00	1.00	3.15
19. Drill grout holes, under 100 ft.—4,500 lin.ft	2.75	1.50	3.25
20. Drill grout holes, over 100 ft.—14,000 lin.ft	3.50	2.00	3.35
21. Pressure grout foundations—28,000 cu.ft	1.00	1.00	1.25
22. Pressure grout contraction joints and cooling system—1,600 cu.ft	2.00	1.00	1.40
23. Drill drainage holes, under 25 ft.—200 lin.ft	4.00	1.00	2.90
24. Drill drainage holes, under 50 ft.—2,300 lin.ft	4.50	1.00	3.00
25. 4-in. sewer drains in porous concrete—180 lin.ft	.70	1.00	.55
26. 6-in. sewer drains, in porous concrete—80 lin.ft	.80	1.00	1.10
27. 6-in. sewer drains in gravel—200 lin.ft	.50	1.00	.55
28. 12-in. sewer drains, in gravel—150 lin.ft	.70	1.00	1.10
29. Porous concrete draintile, complete—7,000 lin.ft	.50	.32	.75
30. Porous concrete—90 cu.yd	7.50	8.80	8.80
31. Weep holes, excl. tunnel—1,000 lin.ft	1.00	1.00	.90
32. Weep holes, tunnel—300 lin.ft	1.00	1.00	.90
33. Drill holes, anchor bars and grout—800 lin.ft	1.00	1.00	.90
34. Concrete, dam—163,000 cu.yd	4.70	3.33	5.42
35. Concrete, curbs and parapets—260 cu.yd	17.00	11.80	16.2
36. Concrete, trash rack structures—4,200 cu.yd	12.00	12.70	16.0
37. Concrete, spillway gate to El. 6403—4,200 cu.yd	12.00	30.00	20.0
38. Concrete, spillway gate above El. 6403—320 cu.yd	30.00	15.50	25.00
39. Concrete, spillway tunnel, well shaft—4,600 cu.yd	13.00	20.00	13.0
40. Concrete spillway counterweights—60 cu.yd	12.00	14.00	11.0
41. Concrete, power plant below generator floor—12,400 cu.yd	11.50	20.00	10.00
42. Concrete, power plant above floor—1,500 cu.yd	21.00	20.80	25.00
43. Concrete paving—340 cu.yd	7.00	11.30	10.00
44. Place reinforcing bars and fabric—2,550,000 lb	.017	.025	.025
45. Concrete surface, special finish—7,500 sq.yd	.60	.40	.55
46. Install metal sealing strips, contraction joints—7,000 lin.ft	.30	.20	.45
47. Install grout pipe etc., contraction joint—45,000 lb	.12	.075	.11
48. Install metal pipe etc., concrete cooling system—160,000 lb	.10	.055	.09
49. Furnish, install, operate concrete cooling system—total	25,000.00	29,552.00	26,000.00
50. Install metal sealing strips, contraction joints, struct.—800 lin.ft	.30	.40	.45
51. Install metal sealing strips, construction joints, struct.—3,800 lin.ft	.30	.20	.45
52. Install expansion joint filler—400 sq.ft	.40	.25	.65
53. Install 4-in. dia. sewer drains, contraction joints—800 lin.ft	.40	.40	.65
54. Install spillway gate structure—350,000 lb	.02	.035	.033
55. Install spillway gate operating mechanism—100,000 lb	.03	.085	.044
56. Install trash rack metal work—970,000 lb	.01	.035	.027
57. Install penstock bulkhead gate, etc.—140,000 lb	.025	.05	.028
58. Install paradox gates and operators—412,000 lb	.017	.035	.022
59. Install power penstocks and outlet pipes—339,000 lb	.025	.035	.022
60. Install internal differ. needle valves and operators—116,000 lb	.017	.05	.022
61. Install travel and gantry cranes—170,000 lb	.025	.07	.022
62. Install track rails—29,000 lb	.025	.035	.022
63. Erect struct. steel, power house—111,000 lb	.02	.035	.022
64. Install metal tubing, pipes, fittings, etc.—192,000 lb	.10	.07	.055
65 Install asphalt felt roof and flashing—8,400 sq.ft	.15	.10	.022
66. Construct hollow walls, metal lath and plaster—100 sq.yd	2.00	2.50	2.20
67. Construct suspended ceilings—150 sq.yd	2.00	2.00	3.30
68. Paint concrete walls—400 sq.yd	.50	.50	.55
69. Light weight concrete, floors—150 cu.yd	8.00	5.50	18.00
70. Place bonded concrete floor finish and base—2,840 sq.yd	1.50	2.00	1.10
71. Install membrane waterproofing—500 sq.ft	.25	.20	.17
72. Install metal stairways—16,000 lb	.07	.05	.05
73. Install metal floor plates, gratings—36,600 lb	.03	.04	.05
74. Install sump pumps, accessories—3,500 lb	.04	.115	.11
75. Install metal accordion doors—660 sq.ft	.60	.50	.45
76. Install metal swinging doors—460 sq.ft	.70	.50	.45
77. Install metal sash windows—2,100 sq.ft	.50	.25	.45
78. Install metal sash window operators—4,000 lb	.07	.10	.13
79. Install metal partition—150 sq.ft	.80	1.00	.44
80. Install misc. metal work—67,000 lb	.10	.05	.14
81. Install wooden doors—200 sq.ft	.50	.50	.35
82. Install plumbing fixtures, etc.—900 lb	.10	.20	.28
83. Install elec. metal conduit up to 1½-in. dia.—12,700 lin.ft	.15	.20	.22
84. Install elec. conduit, up to 3-in. dia.—11,400 lin.ft	.20	.25	.28
85. Install elec. fiber conduit—1,600 lin.ft	.15	.15	.28
86. Install ground wires and rods—3,000 lb	.15	.20	.11
87. Install elect. cable, misc. instruments—10,000 lin.ft	.10	.15	.11
88. Transport misc. freight other than contractors, between Parco, Wyoming and dam site—30,000 cwt	.30	.44	1.10